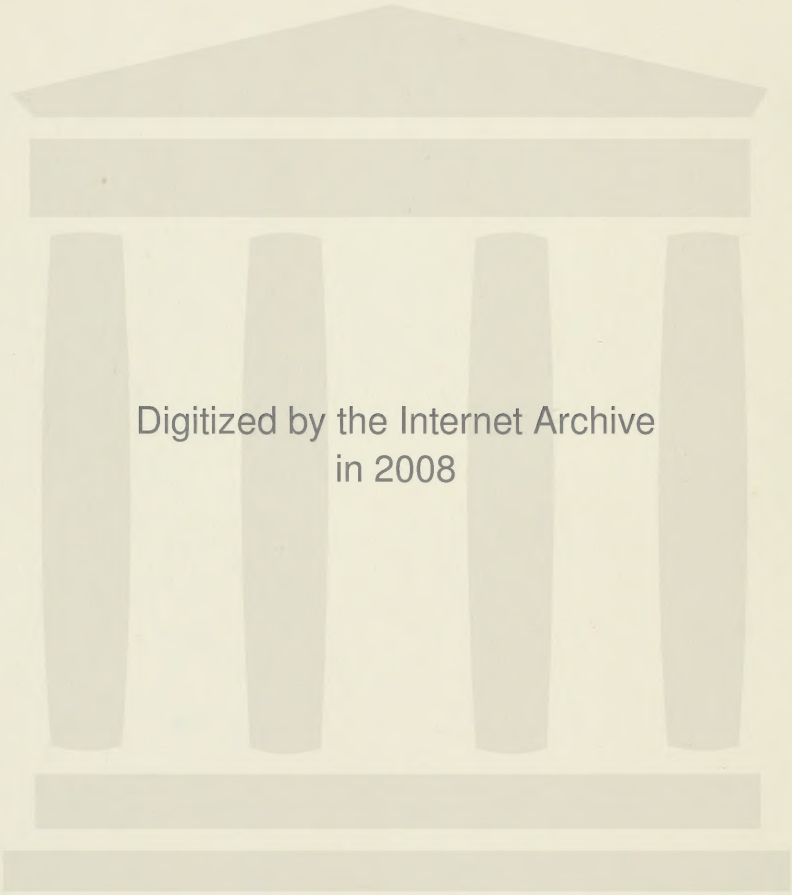
CA1
YS
-S27


Digitized by the Internet Archive
in 2008

http://archive.org/details/n23sessionalpaper45canauoft

SESSIONAL PAPERS

VOLUME 23

THIRD SESSION OF THE ELEVENTH PARLIAMENT

OF THE

DOMINION OF CANADA

SESSION 1911

126373
18/2/13

VOLUME XLV.

See also Numerical List, Page 7.

ALPHABETICAL INDEX

TO THE

SESSIONAL PAPERS

OF THE

PARLIAMENT OF CANADA

THIRD SESSION, ELEVENTH PARLIAMENT, 1911.

A

Accidents on I.C.R.. .. ..83, 83*a*
Acton Vale, Post Office at.. 86
Accidents on railways.. 145
Admiralty Court in Nova Scotia.. 107
Adulteration of Food.. 14
Advalorem Duty.. 75
Agriculture, Annual Report.. 15
Agriculture and other products.. 173
Alaskan Boundary Commission, Report of.. 139
Alberta and Saskatchewan, control of lands, &c... .. ..106, 106*a*
Alberta and Saskatchewan, sale of lands in.. 133
Alberta and Saskatchewan Fisheries Commission.. 211
Aliens in the service of the Government 198
Annuities, Government.. 47
Astronomer, Chief, Report of.. .. .. .. 25*a*
Atlantic, Quebec and Western Railway.. .. ..89, 128, 128*b*
Athol Post Office, mail route.. 105
Atlantic Fisheries, Hague Award.. .. 97*b*
Atlantic Service, Fast.. 200
Auditor General, Annual Report.. 1
Australian Commonwealth, Reciprocal Trade with.. 109

B

Baby Farm, correspondence relative to.. 126
Banks Chartered.. 6
Bankers' Association, Rules, &c., of.. 153
Banks, Unpaid Balances in.. 7
Barnhill, Major J. L.. 185
Barracks Site at Toronto.. 126
Battlefields Commission:—
Memorandum respecting Finances.. . 58
Report from.. .. . . 58*a*
Report made to Government.. .. .. .. 58*b*
Appointment of Members of.. .. .. 58*c*
Medals struck by.. .. .. 58*d*
Beauharnois Canal, Lighting of.. .. .. 98*a*
Beauharnois Canal, Sums paid by Concessionaries.. .. ..98*b*, 98*e*
Bear River, N.S., Rifle Range at.. 183
Bituminous Coal, imported.. 205
Boot Last Blocks.. 66
Bonds and Securities 49
British Canadian Loan and Investment Company 164
Bryce, Dr. P. H., Report of.. .. .. .. 25*c*
Burk's Falls, Wharf at.. 111
Butter and Eggs, Imported, and Prices of.. .. .. 179, 179*a*, 179*b*
By-Elections.. 18

C

Cab Hire and Street Ry. Fares in Ottawa.. 175
Canada and West Indies, Trade Relations.. 38
Canadian Atlantic Fishermen 84
Canadian Bankers' Association, Rules, &c. 153
Canadian Light, Heat & Power Co... .. 98*a*
Canadian Pacific Railway:—
Orders in Council, &c., &c. 55
Lands sold by.. .. .. 55*a*
Bridge at Lachine 80
Canadian Trade 10*c*
Canadians Accepted in Navy.. .. .. .. 56*a*
Canal Statistics 20*a*
Carrier & Lainé, Lévis, Expropriation of Property of .. .. p.p. 87, 87*a*, 87*b*, 87*c*, 87*d*
Census, Methods of taking 189, 189*b*, 189*c*
Census Schedules 189*a*
Charing Cross Bank 189
Chartered Banks 6
Chrysler, F. H., K.C., monies paid to.. 118
Chinese Frauds on Pacific Coast.. 207
Civil Service:—
Appointments and Promotions, Commissioners' Annual Report 31
List 30
Insurance Act 43
Employees at Ottawa 135
Clayoquot Life Saving Station 68
Comparative Prices, Canada and United States 36*b*
Coal Imported 205
Conciliation Board 202
Conference at Washington, *re* Fisheries 97, 98*a*
"Coquette", Trawler 85
Conservation Commission, &c. 52
Contract for Bridges 77
Creighton, W. O., Farmers' Delegate .. 76*g*
Criminal Statistics.. 7
Cumberland Coal and Railway Co. 72
Curator's Reports on Banks 152, 152*a*
Curran, R. E., Railway Mail Clerk.. .. 160
Customs Department, Annual Report.. 11
Customs Entries at Vancouver 102
Custom House Employees, Montreal.. .. 69
Customs Tariff Act 70, 75, 102*a*

D

Dairy and Cold Storage Commissioner.. 15*a*
'Daily Telegraph,' Quebec, monies paid to.. 147
Davis, M. P., Contractor.. .. .. 137*a*
Debates, Publication and Distribution of... .. ..115, 115*a*
De Courcey, Mr., amounts paid to.. ..74*j*, 74*e*
Deep Brook, N.S., Wharf at.. 193

D

Departments, obliged to Report to Parliament.. 127
Destructive Insects.. 51
Dickie Martin, Appointment of.. 185
Dividends unpaid in Banks.. 7
Divorces granted by Parliament, &c...116, 168
Dominion Lands, Survey.. .. .. ..60, 60*a*, 60*b*
Dominion Police.. 81
Dominion Lands.. .. ..96, 96*a*, 96*b*
Dominion Navies, Status of.. .. .. .. 208*a*
Drill Halls, or Armouries, contributions to.. 129
Drolet, Jean, amounts paid to.. .. .. .. 74*h*
Dussault & Lemieux, amounts paid to.. 93*d*
Dutch Loan Company.. 95

E

Eclipse Manufacturing Co., monies paid to.. 180
Elections, House of Commons.. 18
Electric installation at Quebec.. 117
Electric Light, inspection of.. 13
Elbow River, Water Power on.. .. ..123, 123*a*
Employees, Sessional, House of Commons.. .. .. 103*a*
Employees of Government at Montreal 69*a*
Employees of Government in Municipal Affairs.. .. ..195, 195*a*
Erie, Lake, and Great Lakes System.. 54
Estimates.. .. ..3 to 4, 5, 5*a*, 5*b*, 5*c*
'Essex Record,' monies paid to.. .. .. 74*m*
Excise Revenue.. 12
Exchequer Court Rules.. 197
Experimental Farms.. 16
External Affairs, Annual Report.. .. .. 29*b*

F

Farmer's Bank, Papers relating to..110, 110*a*
Farmers' Delegation.. 113
Fast Atlantic Service.. 200
Fisheries, Annual Report.. 22
Fish landed.. 84
Fisheries Act, changes in.. .. .. 97*a*
Fishery Bounty, names of persons receiving.. .. ..158, 158*a*
Fisheries Commission, Manitoba, Report of.. 174
Fisheries Commission, Alberta, Interim Report.. 211
Fishing in the Bays, Rights of.. 62
Fisheries Officers, Names, Salaries and Duties of.. 165
Fishery Regulations, Breaches of.. ..91, 91*a*
Fishery Wardens in Victoria Co., N.S. 165*a*
Food, Adulteration of.. 14
Forest Reserve Act.. 61
France, Trade Relations with.. .. .. .. 10*a*

F

French, Genl. Sir John, Report of.. .. .. 35a
Fruit and Vegetable Growers, Deputation of.. .. .. 113a

G

Gas, Inspection of.. 13
Geographic Board.. .. .. 21a
General Orders, Militia.. 41
Geological Survey, Report.. 26
Germany, Trade Relations with.. .. .. 10a
Georgian Bay Canal.. .. ..98, 98c
Glace Bay, Bait Association.. 177
Governor General's Warrants.. 42
Godleib, Said, Detention of, at Grosse Isle.. 167
Grain Statistics.. .. .. 10d
Grand Trunk Railway Co., Strike on..72a, 72b
Greenway, Thomas, Correspondence with 96b
Guysborough 'Times,' Postal Privileges 187

H

Hague Tribunal Award.. .. .. 97b
Haney, Quinlan & Robertson.. .. .. .. 77a
Harbours and Rivers, Amounts Expended on.. 184
Harbour Commissioners.. 23
'Herald,' Montreal, amounts paid to.. 74a
Hickman, W. A., Immigration Agent.. 76h
Holmes, Rt. Rev. Geo., D.D.. .. .. 130a
House of Commons:—
Internal Economy.. 46
By-Elections.. 18
Sessional Employees.. 103
Hydrographic Survey.. .. .. 25a

I

Ice Formation on the St. Lawrence.. .. 21b
Immigration, Interior Report, Part II.. 25c
Immigration:—
Japanese Immigrants.. 76
Special Agents.. .. .. 76a
Number of Arrivals.. .. .. 76b
Claims of Restaurant Keepers.. .. .. 76c
Complaints against J. Dery.. .. .. .. 76d
Complaints against Restaurant Keepers.. .. .. 76e
Letter by Mr. L. Stein.. .. .. 76f
Payments to W. O. Creighton.. .. .. 76g
Payments to W. A. Hickman.. .. .. .. 76h
Imperial Conference, Minutes of.. 208
Imperial Conference, Admiralty Conferences 208a, 208b, 208c
Imperial Conference, Military Conference.. .. .. 208d
Imperial Conference Secretariat, &c.. .. 176
Importations from the United States..131, 131a
Imports and Exports, 1846 to 1876.. .. .. 109c

I

Indian Reserves, Petroleum on.. 53
Indian Affairs, Annual Report.. 27
Indian Reserve, St. Peters.. .. ..71, 71a
Inland Revenue, Annual Report.. 12
Insect Pests.. 57
Insurance Act, Civil Service.. 43
Insurance, Annual Report.. 8
Insurance, Abstract.. 9
Intercolonial Railway, Accidents to Trains.. .. ..83, 83a
Intercolonial Railway, Renewal Equipment.. .. .. 83b
Intercolonial Railway, Maintenance Account.. .. .. 83b
Intercolonial Railway, Sleepers for.. .. 83c
Intercolonial Railway, East and Westbound Traffic.. 203
Internal Economy.. 46
International Waterways.. .. ..54, 54a
International Naval Conference.. .. .. 56m
'International,' Dredge, Work done by.. 93d
Interior, Annual Report.. 25
Inquiry Public Printing and Stationery. 39
Irrigation Grant, the Percy Aylwin.. .. 192
Irwin, Fanny Louise, Timber on Homestead of.. 132

J

Japanese Immigrants.. 76
Japan, Treaty with.. .. ..95d, 9
Jetté, His Honour, Judge, Administrator of Quebec.. 114
Journals, Distribution of.. .. .. 115b
Judges Residences in the Prov. of Quebec.. 170
Judges, Appointment of.. 199
Justice, Annual Report.. 34

K

Kelliher and Gordon, Agreement *re* N. T. R.. .. .. 77h
Kingston Firms, Supplies, &c., purchased from.. 156
Krenzer, J., Correspondence with.. .. .. 96b

L

Labour, Annual Report.. 36
Labour, Department of, Correspondence *re* Quebec Bridge.. .. .. 137c
Labour Gazette, Mailing List of.. 92
Lake, Genl. Sir P. H. N., Report of.. .. 35b
Lands, Dominion.. .. ..96, 96a, 96b
Laliberté, J. B., amounts paid to.. .. 146
La Patrie, amounts paid to.. .. .. 74d
La Presse, amounts paid to.. .. .. 74e
Law Firms, amounts paid to.. 99
La Vigie, amounts paid to.. .. .. 74c

L

Le Canada, amounts paid to.. .. .. ..74*f*, 74*k*
Letourneau, Louis, amounts paid to.. .. 148
Le Soleil, amounts paid to.. .. .. 74*b*
Letter Carriers in New Westminster.. .. 166
Lighthouse Keepers on River St. Lawrence.. .. ..94, 94*a*
Library of Parliament, Annual Report.. 33
List of Shipping.. .. .. 21*c*
Lobster Fishery Regulations.. 48
Long Sault, Works at.. .. ..157, 157*a*
Louisburg, Bait Freezers at 177*a*

M

Mahone Bay, Dismissal of Sub-collector at.. 161
'Manchester Engineer,' Stranding of.. .. 182
Malboeuf, Jos. William, Half-breed Scrip, issued to.. 130
Manitoba Boundary.. 57
Manitoba Fisheries Commission.. 174
Manitoba and South-eastern Railway Co. 196
Marine, Annual Report.. 21
Martineau Company, monies paid to.. .. 74*j*
Measures, Inspection of.. 13
Montreal Herald, amounts paid to.. .. 74*a*
Militia Council, Annual Report.. 35
Militia, General Orders.. 41
Militia Council, Interim Report.. .. .. 35*c*
Ministers of the Crown, Travelling Expenses of.. 172
Mines, Report of Department.. .. .. .. 26*a*
Mint, Operations of the.. 73
Miramichi Bay, Dredging in.. .. .. 93*a*
Miscellaneous, Unforseen Expenses.. .. 44
Meat Packers of Ontario and Quebec, Memorandum by.. .. .. 113*b*
Montreal Herald, amounts paid to.. .. 74*a*
'Montcalm,' Trips Made by Steamer.. .. 169
Montreal, Government Employees at.. .. 69*a*
Mounted Police.. 28

Mc

McDougall, Rev. John.. .. .. 71*a*

N

National Battlefields Commission.. .. ..
National Transcontinental Railway:—
Sixth Report of Commissioners.. 37
Concrete used in Construction.. .. .. 77*f*
Contracts for Bridges.. 77
Contracts at Winnipeg and St. Boniface.. .. .. 77*m*
Cost of Structures.. .. .. 77*c*
Eastern Division, Expenditure on.. .. 77*o*
Engineering Staff on.. .. .. 77*a*
Estimated Cost; Actual Cost.. .. .. .. 77*i*
Honey, Quinlan & Robertson, Contract of.. .. .. 77*a*

N

Interim Report of Commissioners.. .. 77*k*
Kelliher and Gordon, Agreement between.. .. .. 77*h*
Length in Miles of each Division, from Moncton to Winnipeg.. .. .. 77*l*
Over-classification or over-allowance.. 77*n*
Payments to Contractors.. .. .. 77*e*
Quantities of each kind of Excavation 77*b*
Spur Line to Quebec.. .. .. 77*p*
Total Expenditure on.. .. .. 77*j*
Train-hauled Filling.. .. .. 77*d*
58, 58*a*, 58*b*, 58*c*
Napanee River, Dredging of.. 93
Natural Gas, on Six Nation Reserve.. 71*c*
Naval Service of Canada:—
Applications for Service in.. .. .. .. 56*c*
Allowances to Petty Officers, &c.. .. .. 56*f*
Canadians Accepted in Navy.. .. .. .. 56*n*
Deputy Minister and other Officers in 56*d*
Expenditure in Connection with.. .. .. 56*b*
Increase of Wages Authorized.. .. .. 56*g*
International Naval Conference in London.. .. .. 56*l*
International Naval Conference, Correspondence.. .. .. 56*m*
Names of Employees in.. .. .. 56*e*
Name, Tonnage, &c., of each Ship.. .. 56*j*
Orders in Council, Travelling Allowances, &c.. .. .. 56*k*
Petitions for Postponement of Adoption of.. .. .. 56*i*
Regulations *re* Entry of Surgeons.. .. 56*o*
Rules and Regulations for.. .. .. 56*h*
Regulations in, *re* Rates of Pay.. 56
Regulations in, *re* Issue of Clothing.. 56*a*
Nelson River Survey.. 196
Newmarket Canal, Correspondence, &c.. 204
New Westminster, Penitentiary at.. .. 112
Newspapers, sums paid to 64
Netherland Loan Co.. .. .. ..95, 95*a*, 95*b*, 95*c*
North Atlantic Coast Fisheries.. 97
Northwest Territories Act, Chap. 62.. .. 79
North Bay, Receipts from Wharf at.. 111
Northwest Territories, Commissioner for 181
North Atlantic Collieries.. 155

O

Office Specialty Manufacturing Co., monies paid to.. 180
Opening and Closing of Parliament.. .. 104
Opium Smuggling on Pacific Coast.. .. 207
Orders in Council *re* D.L.S. Act.. 60
Ordinance to rescind Cukon Ordinance 78
Ottawa Improvement Commisison, Report of.. 138
Ottawa River Storage, Progress Report.. 19*a*
Oyster Culture.. 67

P

Paris Exposition, Expenses Incurred for 206
Parliament, Opening and Closing of.. .. 104
Parrsboro, Post Office Building at.. .. 86*a*
Pelagic Sealing Treaty.. 210
Pelletier, Sir Pantaleon, Leave of Absence of.. .. ..88, 88*a*
Penitentiaries, Annual Report.. 34
Penitentiary at New Westminster.. .. 112
Percy Alwyn, Irrigation Grant 192
Petroleum and Gas Regulations.. 53
Phœnix Bridge Co., Payment by.. 82
Picard, O., & Sons, money paid to.. .. 74*i*
Police, Dominion.. 81
Police, Royal Northwest Mounted.. .. 28
Postmaster General, Annual Report.. .. 34
Powassan to Nipissing, Mail Route.. .. 171
Preston, W. T. R... .. ..95, 95*a*, 95*b*, 95*c*
Preferential Tarriff, Goods Imported under.. 142
Prince Edward Island, Winter Steamers 159
Prince Edward Island, Tunnel.. 188
Printing Bureau, Employees of.. 190
Printing, &c., Government.. 74
Provincial Control of Lands, &c.. ..106, 106*a*
Proclamation bringing into Force 'An Act to Amend the Ry Act.' 108
Public Accounts, Annual Report.. 2
Public Lands, &c., Disposition of.. ..141, 141*a*
Public Printing and Stationery.. 32
Public Printing and Stationery Inquiry 39
Public Works, Annual Report.. 19

Q

Quebec, Extension of Boundaries of.. .. 65
Quebec Oriental Railway.. 89, 128, 128*a*, 128*b*
Quebec Board of Trade, Resolutions by.. 122
Quebec, Temporary Employees at.. .. .. 120*a*
Quebec Bridge Co., Legal Existence of.125, 125*a*
Quebec Bridge, Tenders, &c., for.. ..137, 137*a*
Quebec Bridge, Engineers Appointed.. 137*b*
Quebec Bridge, Correspondence *re* Plans for New Bridge.. .. .. 137*d*
Quebec Bridge, Correspondence, Department of Labour *re*.. .. .. 137*c*

R

Railways Owned or Operated in United States by Canadian Railways.. 186
Railways and Canals, Annual Report.. 20
Railway Commissioners, Report of.. .. 20*c*
Railway Statistics.. .. .. 20*b*
Reciprocity with the United States.. from 59 to 59*s*
Reciprocal Trade with the Australian Commonwealth.. 109
Reconnaisance Survey of the Nelson River.. .. .. 19*b*

R

Retiring Allowances.. 45
River des Prairies, Dredging Work Executed.. .. ..93*b*, 93*c*
Royal Northwest Mounted Police.. 28

S

Samson & Filion, Quebec, monies paid to 124
Saskatchewan University, Land Grant for.. 143
Secretary of State, Annual Report.. .. 29
Senate, Cost of.. 100
Sessional Employees, House of Commons 103*a*
Seventh Military District, Complaint against Commandant.. 178
Seybold Building, Cost of Alterations and Repairs to.. 154
Shareholders in Chartered Banks.. 6
Sherwin-Williams Paint Co., amounts paid to.. 124
Shipping, List of.. .. .. 21*c*
Six Nation Reserve, Natural Gas on.. .. 71*c*
South Grey, Appointments in.. .. ..120, 120*a*
Southwest ¼ Section 10, Township 38.. 96
Stadacona Farm, Purchase of.. 191
Steamboat Inspection.. .. .. 23*a*
St. Peters Indian Reserve.. .. ..71, 71*a*, 71*b*
St. Pie, Post Office at.. 86
S.S. 'Minto,' 'Stanley' and 'Earl Grey,' Coal Purchased for.. .. ..136, 136*b*
Superannuation, &c.. 45
Surveyor General, Report, &c.. 25
Supplies bought from Firms in Kingston.. 156
Subsidized Steamship Services.. .. .. .. 10*e*
Subsidy Act, 1910.. 207

T

Tanguay, George, Lease of Government Property.. 140
Tanguay, George, Quebec, monies paid to 150
Tariff Relations with the United States 109*a*, 109*b*
Taschereau, C. E., Quebec, monies paid to.. 150
Topographical Surveys Branch.. .. .. .. 25*b*
Trade and Commerce, Canadian Trade.. 10*c*
Trade and Commerce.. 10
Trade and Navigation.. .. ..

T

Transcontinental Railway, Contract for Bridges.. .. ..77, 77*a*
Travelling Expenses of Ministers, &c.. 175*a*, 175*b*
Treaty of Commerce, &c., with Japan.95*d*, 95*e*
Treaty *re* Pelagic Sealing.. 110
Trent Valley Canal, Lease of Water Power on.. .. .. 98*d*
Trout Lake, Mail Route.. 171

U

Unclaimed Balances in Banks.. 7
Unforseen Expenses.. 44
United Kingdom, Trade Relations with 10*a*
United States, Trade Relations with.. .. 10*a*
United States Consuls in Dominion.. .. 101
University of Saskatchewan, Land Grant for.. 143

V

Vancouver, Customs Entries at.. 102
Vancouver Dry Dock Company.. 162
Vannutelli, Cardinal, Guard and Escort for.. 121
Veterinary Director General, Report of.. 15*b*

V

Vice-Regal Drawing Room, Correspondence *re*.. 63
Voters' Lists, Printing of.. 209

W

Walsh, E. J., C.E., Correspondence with 204
Wanda,' Appraising of the.. 163
Warrants, Governor General's.. 42
Weights, Measures, &c.. 13
Weigher, Appointment of at Montreal 134
Wentworth, Constituency, Appointments in.. .. .. 120*c*
Welland Canal, Enlargement.. .. .. ..98, 98*c*
Western Coal Operators' Association.. 202
Wheat Exported from Canada.. 119
Winnipeg River, Water Power Rights on 144
Winnipeg, Parliament Site in.. .. ..194, 194*a*
Wireless Telegraph Stations.. 90
'Wren,' the Trawler.. 85

Y

Yukon, Ordinances of Council, 1909.. .. 40
Yukon, Ordinances Rescinded.. 78
Yukon, Ordinances of Council, 1910.. .. 40*a*

See also Alphabetical List, Page 1.

LIST OF SESSIONAL PAPERS

Arranged in Numerical Order, with their titles at full length; the dates when Ordered and when Presented to the Houses of Parliament; the Names of the Senator or Member who moved for each Sessional Paper, and whether it is ordered to be Printed or Not Printed.

CONTENTS OF VOLUME 1.

(This volume is bound in two parts.)

1. Report of the Auditor General for the year ended 31st March, 1910. Volume I, Parts A to P, and Volume II, Parts Q to Y. Presented 21st November, 1910, by Hon. William Paterson.. .. ..*Printed for both distribution and sessional papers.*

CONTENTS OF VOLUME 2.

2. Public Accounts of Canada, for the fiscal year ended 31st March, 1910. Presented 21st November, 1910, by Hon. William Paterson.
Printed for both distribution and sessional papers.

3. Estimates for the fiscal year ending 31st March, 1912. Presented 2nd December, 1910, by Rt. Hon. Sir Wilfrid Laurier... ..*Printed for both distribution and sessional papers.*

4. Supplementary Estimates for the fiscal year ending 31st March, 1911. Presented 6th February, 1911, by Hon. W. S. Fielding.
Printed for both distribution and sessional papers.

5. Further Supplementary Estimates of sums required for the service of the Dominion for the year ending on 31st March, 1911. Presented 16th March, 1911, by Hon. W. S. Fielding.. .. ..*Printed for both distribution and sessional papers.*

5*a*. Further Supplementary Estimates for the year esding 31st March, 1911. Presented 8th May, 1911, by Hon. W. S. Fielding.
Printed for both distribution and sessional papers.

5*b*. Further Supplementary Estimates for the fiscal year ended 31st March, 1911. Presented 3rd May, 1911, by Hon. W. S. Fielding.
Printed for both distribution and sessional papers.

5*c*. Further Supplementary Estimates for the fisel year ending 31st March, 1912. Presented 9th May, 1911. by Hon. W. S. Fielding.
Printed for both distribution and sessional papers.

5*d*. Further Supplementary Estimates of sums required for the service of the Dominion for the year ending on 31st March, 1912. Presented 17th May, 1911. by W. S. Fielding.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 2—*Concluded.*

6. List of shareholders in the Chartered Banks of the Dominion of Canada as on December 31, 1910. Presented 10th April, 1911, by Hon. W. S. Fielding.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 3.

7. Report on dividends remaining unpaid, unclaimed balances and unpaid drafts and bills of exchange in Chartered Banks of the Dominion of Canada, for five years and upwards prior to December 31, 1910. Presented 19th July, 1911, by Hon. William Templeman.. .. ..*Printed for both distribution and sessional papers.*

CONTENTS OF VOLUME 4.

8. Report of the Superintendent of Insurance, for the year ended 31st December, 1910.
Printed for both distribution and sessional papers.

9. Abstract of Statements of Insurance Companies in Canada for the year ended 31st December, 1910. Presented 27th April, 1911, by Hon. W. S. Fielding.
Printed for distribution.

CONTENTS OF VOLUME 5.

10. Report of the Department of Trade and Commerce, for the fiscal year ended 31st March, 1910. Part 1, Canadian Trade. Presented 22nd November, 1910, by Rt. Hon. Sir Wilfrid Laurier.. .. ..*Printed for both distribution and sessional papers.*

10*a*. Report of the Department of Trade and Commerce, Part II. Canadian Trade with France, Germany, United Kingdom and United States. Presented 32nd November, 1910, by Rt. Hon. Sir Wilfrid Laurier.
Printed for both distribution and sessional papers.

10*b*. Report of the Department of Trade and Commerce, Part III. Canadian Trade with foreign countries, except France, Germany, the United Kingdom and United States Presented 22nd November, 1910, by Rt. Hon. Sir Wilfrid Laurier.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 6.

10*c*, Report of the Department of Trade and Commerce for the fiscal year ended 31st March, 1910. Part IV, Canadian Trade, Miscellaneous. Presented 31st March, 1911, by Hon. W. S. Fielding.. .. ..*Printed for both distribution and sessional papers.*

10*d*. Report of the Department of Trade and Commerce for the fiscal year ended March 31st 1910. Part V, Grain Statistics, including the crop year ended August 31st 1910, and the season of navigation ended December 6th, 1910. Presented 12th May, 1911, by Hon. William Paterson....*Printed for both distribution and sessional papers.*

10*e*. Report of the Department of Trade and Commerce for the fiscal year ended 31st March, 1910, Part VI., Subsidized steamship services. Presented 20th April, 1911, by Hon. William Paterson.. .. ..*Printed for both distribution and sessional papers.*

10*f* Report of Trade and Commerce for the fiscal year ended 31st March, 1910, part VII.—Trade of foreign countries and Treaties and Conventions. Presented 31st March, 1911, by Hon. W. S. Fielding.. ..*Printed for both distribution and sessional papers.*

CONTENTS OF VOLUME 7.

11. Report of the Department of Customs, for the year ended 31st March, 1910. Presented 21st November, 1910, by Hon. William Paterson.
Printed for both distribution and sessional papers.

12. Reports, Returns and Statistics of the Inland Revenue for the Dominion of Canada, for the year ended 31st March, 1910. Presented 21st November, by Hon. William Templeman.. .. ..*Printed for both distribution and sessional papers.*

CONTENTS OF VOLUME 8.

13. Inspection of Weights and Measures, Gas and Electric Light, for the year ended 31st March, 1910. Presented 21st November, 1910, by Hon. William Templeman.
Printed for both distribution and sessional papers.

14. Report on Adulteration of Food, for the year ended 31st March, 1910. Presented 21st November, 1910, by Hon. William Templeman.
Printed for both distribution and sessional papers.

15. Report of the Minister of Agriculture for the Dominion of Canada, for the year ended 31st March, 1910. Presented 21st November, 1910, by Hon. S. A. Fisher.
Printed for both distribution and sessional papers.

15a. Report of the Dairy and Cold Storage Commissioner for the fiscal year ending the 31st March, 1910. Presented 12th January, 1911, by Hon. S. A. Fisher.
Printed for both distribution and sessional papers.

15b. Report of the Veterinary Director General and Live Stock Commissioner, J. G. Rutherford, V.S., for the year ending 31st March, 1909.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 9.

16. Report of the Director and Officers of the Experimental Farms, for the year ending 31st March, 1910. Presented 21st November, 1910, by Hon. S. A. Fisher.
Printed for both distribution and sessional papers.

17. Criminal Statistics for the year ended 30th September, 1909. Presented 21st November, 1910, by Hon. S. A. Fisher.. .. ..*Printed for both distribution and sessional papers.*

CONTENTS OF VOLUME 10.

18. (1908). Return of the eleventh general election for the House of Commons of Canada, held on the 19th and 26th of October, 1908.. .. ..*Reprinted.*

18. Return of By-Elections (Eleventh Parliament) House of Commons. 1910.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 11.

19. Report of the Minister of Public Works on the works under his control for the year ended 31st March, 1910. Presented 21st November, 1910, by Hon. William Pugsley.
Printed for both distribution and sessional papers.

19a. Progress Report Ottawa River Storage, for the fiscal year 1909-1910 (supplementing investigations in regard to Georgian Bay Ship Canal project). Presented 6th March, 1911, by Hon. William Pugsley..*Printed for both distribution and sessional papers.*

CONTENTS OF VOLUME 12.

19b. Report upon Reconnaisance Survey of the Nelson River, September-October, 1909. Presented 16th February, 1911, by Hon. William Pugsley.
Printed for both distribution and sessional papers.

20. Report of the Department of Railways and Canals, for the fiscal year ended 31st March, 1910. Presented 21st November, 1910, by Hon. G. P. Graham.
Printed for both distribution and sessional papers.

20a. (1909.) Canal Statistics for the season of navigation, 1909. Presented 21st March, 1910, by Hon. G. P. Graham .. .. ..*Printed for both distrbiution and sessional papers.*

20*a*. Canal Statistics for the season of navigation, 1910. Presented 10th April, 1911, by Hon. G. P. Graham.. .. ..*Printed for both distribution and sessional papers.*

20b. Railway Statistics of the Dominion of Canada, for the year ended 30th June, 1910. Presented 16th December, 1910, by Hon. G. P. Graham.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 13.

20c. Fifth Report of the Board of Railway Commissioners for Canada, for the year ending 31st March, 1910. Presented 21st November, 1910, by Hon. G. P. Graham.
Printed for both distribution and sessional papers.

21. Report of the Department of Marine and Fisheries (Marine, 1910. Presented 21st November, 1910, by Hon. L. P. Brodeur.
Printed for both distribution and sessional papers.

21*a*. Report of the Geographic Board of Canada containing all decisions to 30th June, 1910.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 14.

21b. Report on Ice formation in the St. Lawrence River, and Report of the influence of Icebergs on the temperature of the Sea as shown by use of the Micro-Thermometer in a trip to Hudson Strait and Bay in July, 1910, by H. T. Barnes, D.Sc., F.R.S.C. Presented 16th May, 1911, by Hon. S. A. Fisher.
Printed for both distribution and sessional papers.

21c. List of Shipping issued by the Department of Marine and Fisheries, being a list of vessels on the registry books of Canada, on 31st December, 1910. Presented 19th July, 1911, by Hon. L. P. Brodeur.
Printed for both distribution and sessional papers.

22. Report of the Department of Marine and Fisheries (Fisheries), 1910. Presented 21st November, 1910, by Hon. L. P. Brodeur.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 15.

23. Report of the Harbour Commissioners, &c., to 31st December, 1910.
Printed for both distribution and sessional papers.

23a. Report of the Chairman of the Board of Steamboat Inspection, for the fiscal year 1910. Presented 21st November, 1910, by Hon. L. P. Brodeur.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 15—*Concluded.*

24. Report of the Postmaster General for the year ended 31st March, 1910. Presented 22nd November, 1910, by Rt. Hon. Sir Wilfrid Laurier.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 16.

25. Report of the Department of the Interior, for the fiscal year ending 31st March, 1910. Presented 21st November, 1910, by Hon. Frank Oliver.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 17.

25*a*. Report of the Chief Astronomer, Department of the Interior, for year ending 31st. March, 1910.. .. ..*Printed for both distribution and sessional papers.*

25*b*. Annual Report of the Topographical Surveys Branch, Department of the Interior, 1909-10. Presented 31st March, 1911, by Hon. Frank Oliver.
Printed for both distribution and sessional papers.

25*c*. Report of Dr. P. H. Bryce, Chief Medical Officer, Appendix to Report of Superintendent of Immigration. Presented 9th. December, 1910, by Hon. Frank Oliver.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 18.

25*d*. Report of the Hydrographic Survey (Streams measurement). Department of the Interior.. .. ..*Printed for both distribution and sessional papers.*

26. Summary Report of the Geological Survey Branch, Department of Mines, for Calendar year 1910. Presented 19th. July, 1911, by Hon. William TeTmpleman.
Printed for both distribution and sessional papers.

26*a*. (1909) Summary Report of the Mines Branch of Department of Mines, for the calendar year, 1909. Presented 26th. January, 1911, by Hon. William Templeman.
Printed for both distribution and sessional papers.
This is bound in Vol. XVI, 1910.

CONTENTS OF VOLUME 19.

27. Report of the Department of Indian Affairs, for the year ended 31st March, 1910. Presented 21st November, 1910, by Hon. Frank Oliver.
Printed for both distribution and sessional papers.

28. Report of the Royal Northwest Mounted Police, 1910. Presented 2nd December, 1910, by Rt. Hon. Sir Wilfrid Laurier..*Printed for both distribution and sessional papers.*

CONTENTS OF VOLUME 20.

29. Report of the Secretary of State of Canada for the year ended 31st March, 1910. Presented 21st November, 1910, by Hon. Charles Murphy.
Printed for both distribution and sessional papers.

29a. (No issue).

CONTENTS OF VOLUME 20—*Concluded.*

29b. Report of the Secretary of State for External Affairs, for the year ended 31st March, 1910. Presented 21st November, 1910, by Hon. Charles Murphy.
Printed for both distribution and sessional papers.

30. Civil Service List of Canada, 1910. Presented 21st November, 1910, by Hon. Charles Murphy... .. ..*Printed for both distribution and sessional papers.*

CONTENTS OF VOLUME 21.

31. Second Annual Report of the Civil Service Commission of Canada, for the period from 1st September, 1909 to 31st August, 1910. Presented 1st December, 1910, by Hon. Charles Murphy.. .. ..*Printed for both distribution and sessional papers.*

32. Annual Report of the Department of Public Printing and Stationery, for the fiscal year ended 31st March, 1910. Presented 22nd November, 1910. by Hon. Charles Murphy.. .. ..*Printed for both distribution and sessional papers.*

33. Report of the Joint Librarians of Parliament for the year 1910. Presented 17th November, 1910, by the Hon. the Speaker.. .. .. ..*Printed for sessional papers.*

34. Report of the Minister of Justice as to Penitentiaries of Canada, for the fiscal year ended 31st March, 1910. Presented 30th November, 1910, by Hon. A. B. Aylesworth.
Printed for both distribution and sessional papers.

35. Report of the Militia Council, for the fiscal year ending 31st March. 1910. Presented 21st November, 1910, by Hon. Sir Frederick Borden.
Printed for both distribution and sessional papers.

35a. Report of General Sir John French, G.C.B., Inspector General of the Imperial Forces, upon his Inspection of the Canadian Military Forces. Presented 22nd November, 1910, by Hon. Sir Frederick Borden.
Printed for both distribution and sessional papers.

35*b*. Report upon the best method of giving affect to the recommendations of General Sir John French, regarding the Canadian Militia, by Major General Sir P. H. N. Lake, K.C.M.G., Inspector General. Presented 22nd November, 1910, by Hon. Sir Frederick Borden.. .. ..*Printed for distribution and sessional papers.*

35c. Interim Report of the Militia Council for the Dominion of Canada on the Training of the Militia during the season of 1910. Presented 31st March, 1911, by Hon. Sir Frederick Borden.. .. ..*Printed for distribution.*

36. Report of the Department of Labour, for the fiscal year ending 31st March, 1910, including Report of Proceedings under the Industrial Disputes Investigation Act, 1907. Presented 21st November, 1910, by Hon. W. L. Mackenzie King.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 22.

36a. Report on Industrial Disputes in Canada up to 31st March, 1911.
Printed for both distribution and sessional papers.

36b. Comparative prices of Agricultural, Fisheries, Lumber and Mine products in Canada and the United States, 1906-1911. Presented 28th July, 1911, by Hon. W. L. Mackenzie King.. .. ..*Printed for both distribution and sessional papers.*

CONTENTS OF VOLUME 22—*Concluded.*

37. Sixth Report of the Commissioners of the Transcontinental Railway, for the year ending 31st March, 1910. Presented 21st November, 1910, by Hon. G. P. Graham.
Printed for both distribution and sessional papers.

38. Report of the Royal Commission on Trade Relations between Canada and the West Indies, together with Part II, Minutes of evidence taken in Canada and Appendices; Part III, Minutes of evidence taken in the West Indies, and Appendices; and also Part IV, Minutes of evidence taken in London and Appendices. Presented 21st November, 1910, by Ho. William Paterson.. .. ..*Printed for Sessional Papers.*

39. Report of the Honourable the Secretary of State, on the inquiry into the affairs of the Department of Public Printing and Stationery. Presented 21st November, 1910, by Hon. Charles Murphy.. .. .. ..*Printed for both distribution anl sessional papers.*

CONTENTS OF VOLUME 23.

40. Ordinances of the Yukon Territory, passed by the Yukon Council in the year, 1909. Presented 21st November, 1910, by Hon. Charles Murphy.. .. ..*Not printed.*

40a. Ordinances of the Yukon Territory passed by the Yukon Council in the year 1910. Presented 4th April, 1911, by Hon. Charles Murphy.. .. ..*Not printed.*

41. General Orders issued to the Militia, between the 1st November, 1909, and the 18th October, 1910. Presented 22nd November, 1910, by Hon. Sir Frederick Borden.
Not printed.

42. Statement of Governor General's Warrants issued since the last session of Parliament. on account of the fiscal year 1910-11. Presented 22nd November, 1910, by Hon. William Paterson.. .. ..*Not printed.*

43. Statement in pursuance of section 17 of the Civil Service Insurance Act, for the year ending 31st March, 1910. Presented 22nd November, 1910, by Hon. William Paterson.
Not printed.

44. Statement of expenditure on account of miscellaneous unforeseen expenses, from the 1st April, 1910, to 17th November, 1910, in accordance with the Appropriation Act of 1910. Presented 22nd November, 1910, by Hon. William Paterson....*Not printed.*

45. Statement of Superannuation and Retiring Allowances in the Civil Service during the year ending 31st December, 1910, showing name, rank, salary, service, allowance and cause of retirement of each person superannuated or retired, also whether vacancy filled by promotion or by new appointment, and salary of any new appointee. Presented 22nd November, 1911, by Hon. William Paterson.. .. ..*Not printed.*

46. Report of the proceedings of the preceding year, of the Commissioners of Internal Economy of the House of Commons, pursuant to Rule 9. Presented 1st December, 1910, by the Hon. the Speaker.. .. ..*Printed for sessional papers.*

47. Return, in pursuance of section 16, of the Government Annuities Act, 1908, containing statement of the business done during the fiscal year, ending 31st March, 1910. Presented 1st December, 1910, by Hon. S. A. Fisher.. .. ..*Printed for sessional papers.*

48. Return to an order of the House of Commons, dated 1st December, 1910, for a copy of the existing lobster fishery regulations, adopted by Order in Council on 30th September, 1910. Presented 1st December, 1910, by Hon. L. P. Brodeur.
Printed for sessional papers.

CONTENTS OF VOLUME 23—*Continued.*

49. Detailed statement of all bonds or securities registered in the Department of the Secretary of State of Canada, since last return (25th November, 1909), submitted to the Parliament of Canada under Section 32 of Chapter 19, of the Revised Statutes of Canada, 1906. Presented 1st December, 1910, by Hon. Charles Murphy.. ..*Not printed.*

50. Annual Return respecting Trade Unions, under chapter 125, R.S.C., 1906. Presented 1st December, 1910, by Hon. Charles Murphy.. .. ..*Not printed.*

51. Regulations under "The Destructive Insect and Pest Act." Presented 1st December, 1910, by Hon. S. A. Fisher.. .. ..*Not printed.*

52. First Annual Report of the Commission on Conservation, 1910. Presented 5th December, 1910, by Hon. S. A. Fisher.. .. ..*Printed for sessional papers.*

53. Regulations established by Order in Council of 17th May, 1910, for the disposal of petroleum and gas on the Indian Reserves in the Provinces of Alberta and Saskachewan and in the Northwest Territories. Presented 5th December, 1910, by Hon. Charles Murphy.. .. .. y .. .. ..*Not printed.*

54. Report of the International Waterways Commission on the regulation of Lake Erie, with a discussion of the regulation of the Great Lakes System. Presented 7th December, 1910, by Hon. William Pugsley.. .. ..*Printed for sessional papers.*

54*a*. Return to an Address of the House of Commons, dated 12th December, 1910, for a copy of all orders in council or other authority, appointing members of the Canadian section of the Joint International Waterways Commission, together with all reports, recommendations and correspondence submitted to the Government, or any department thereof, by the said Canadian section, or any member thereof. Also a statement of the total expenses of such Canadian section up to date, with particulars thereof. Presented 8th May, 1911.—*Mr. Macdonell*.. .. .. ..*Not printed.*

55. Return in so far as the Department of the Interior is concerned) of copies of all Orders in Council, plans, papers, and correspondence which are required to be presented to the House of Commons, under a Resolution passed on 20th February, 1882, since the date of the last return, under such Resolution. Presented 9th December, 1910, by Hon. Frank Oliver.. .. ..*Not printed.*

55*a*. Return of lands sold by the Canadian Pacific Railway Company during the year which ended on the 31st October, 1910. Presented 4th May, 1911, by Hon. Frank Oliver .. .. *Not printed.*

56. Regulations issued by the Department of the Naval Service regarding rates of Pay, pursuant to Section 47 of the Naval Service Act. Presented 9th December, 1910, by Hon. L. P. Brodeur... .. ..*Not printed.*

56*a*. Regulations issued by the Department of the Naval Service, regarding the issue of the existing Lobster Fishery Regulations, adopted by rder in Council on 30th September, 1910, by Hon. L. P. Brodeur.. .. ..*Not printed.*

56b. Return to an order of the House of Commons, dated 5th December, 1910, for a statement showing the detailed expenditure to date out of the sum voted by the House in connection with the new Navy, giving in each case the amount paid, to whom paid and the object of the expenditure. Presented, 16th December, 1910.—*Mr. Monck*.. .. ..*Not printed.*

CONTENTS OF VOLUME 23—*Continued.*

56*c*. Return to an order of the House of Commons dated 14th December, 1910, for a Return showing how many applications have been received from Canadian citizens for service in the proposed Canadian Navy, as officers, and able seamen or blue-jackets, respectively, and how many officers and men, respectively, of the British Navy have made application for such service. Presented 11th January, 1911.—*Mr. Jameson* .. .. *Not printed.*

56*d*. Return to an address of the Senate dated 24th November, 1910, for the following information:—1. Has the Department of the Naval Service, which was erected by the legislation of last session, been regularly organized and put in operation? 2. Who has been appointed Deputy Minister by the Governor in Council? 3. Who are the other officials and clerks necessary for the proper administration of the affairs of the new department who have been appointed by the Governor in Council? 4. Who among these officials and clerks are those who have been transferred from the Department of Marine and Fisheries to the Department of the Naval Service? 3. Wro among these officials and clerks come from elsewhere? 6. What is the salary of each of the officials? Presented 11th January, 1911.—*Hon. Mr. Landry....Not printed.*

56*e*. Return to an order of the House of Commons, dated 7th December, 1910, for a statement showing:—1. The names of all those engaged to date by the Government in connection with the new Naval Deparment, whether for service at sea or for work in connection with the department, either for inside or outside service. 2. The domicile of origin of those thus engagged, their previous occupation, rank or grade in the British Navy or elsewhere, and previous rate of pay or remuneration 3. The duties assigned, rank or occupation of those thus engaged in the service of Canada, and present salary and allowances. Presented 18th January, 1911.—*Mr. Monk*.. .. ..*Not printed.*

56*f*. Copy of an Order in Council approved by His Excellency the Governor General on the 22nd December, 1910, authorizing certain ollowances to Petty Officers and men in the Naval Service. Presented 19th January, 1911, by Hon. L. P. Brodeur.
Not printed.

56*g*. Copy of an Order in Council approved by His Excellency the Governor General on the 22nd December, 1910, and publisded in the *Canada Gazette* on the 14th January, 1911, authorizing increase in wages to certain ratings in the naval service. Presented 19th January, 1911, by Hon. L. P. Brodeur.. .. ..*Not printed.*

56*h*. Return to an Address of the House of Commons, dated 11th January, 1911, for a return showing all rules and regulations passed by the Governor in Council under the provisions of the Navy Act, adopted at the last session of parliament. Presented 26th January, 1911.—*Mr. Monk*.. .. ..*Not printed.*

56*i*. Return to an order of the Senate dated the 24th November, 1910, for a statement showing in as many distinct columns:—1. The name of the electoral district. 2 The name of the parish, township, town or city. 3. The name of the first signer, and mention of the additional number of signers of each of the petitions presented during the last session, either to the House of Commons or to the Senate, praying for the postponement of the adoption of the proposed Naval Act until the people have had the opportunity of expressing their will by means of a plebiscite. 4. The date of the presentation of each of these petitions. 5. The names, in each case, of the Member or Senator who presented these petitions. Presented 30th November, 1910.—*Hon. Mr. Landry*.. .. ..*Not printed.*

CONTENTS OF VOLUME 23—*Continued.*

56*j*. Return to an order of the Senate dated February 1, 1911, calling for in as many columns:—1. The names of all the ships of which the Canadian fleet service is actually composed. 2. The tonnage of each of these ships. 3. How old, is each ship at present. 4. The purchase price, or cost of construction, or, in default thereof, the actual value of each ship. 5. The horse-power of each of them. 6. The motive power, side wheels, propeller or sails. 7. The number of persons of which the crew of each of these ships is composed. 8. The cost of annual maintenance of each ship with its crew. 9. The purpose for which each ship is used, specifying whether it is for the guarding of the coasts, the protection of fisheries, or for the what other purpose. 10. The waters on which each of these ships sails—the waters of the Atlantic or Pacific Oceans, the Great Lakes, of the St. Lawrence river, or elsewhere, with a short statement showing the number and the net tonnage of the ships of the Great Lakes service,—of the ships stationed on the shores of British Columbia, and of the ships sailing on the waters of the eastern portion of the American continent owned by us. Presented 14th February, 1911.—*Hon. Mr. Landry.*
Not printed.

56*k*. Orders in Council published in *Canada Gazette* 11th February, 1911, No. 83/146. Regulations for entry of naval instructors. No. 91/146. Revised rates of pay for electricians. No. 86/146. Revised travelling allowances. Presented 23rd February, 1911, by Rt. Hon. Sir Richard Cartwright.. .. ..*Not printed.*

56*l*. Return to an address of the House of Commons, dated 6th February, 1911, for a copy of the final protocol or agreement entered into at the International Naval Conference held in London, December, 1908, February, 1909, and of the general report presented to the said Naval Conference on behalf of its drafting committee, and of all correspondence exchanged between the Imperial Government and the Government of Canada in regard to the same. Presented 10th March, 1911.—*Mr. Monk.. .. ..Not printed.*

56*m*. 1. Correspondence and documents respecting the International Naval Conference held in London, December, 1908, February, 1909. 2. Correspondence respecting the Declaration of London. 3. Final Act of the Second Peace Conference held at The Hague in 1907, and Conventions and Declarations annexed thereto. Presented 23rd March, 1911, by Rt. Hon. Sir Wilfrid Laurier.. .. ..*Not printed*

56*n*. Return to an order of the House of Commons, dated 27th February, 1911, for a Return showing:—1. How many Canadians have been accepted as members of the Canadian Navy. 2. What are the names and former residence of those who have been accepted. Presented 24th March, 1911.—*Mr. Taylor (Leeds),.. .. .. ..Not printed.*

56*o*. Order in Council, approved by His Excellency the Governor General on the 31st March, 1911, and published in the *Canada Gazette* April 15th, 1911:—No. 358 revised regulations for entry of surgeons into the Naval Service. Presented 24th April, 1911, by Hon. L. P. Brodeur.. .. ..*Not printed.*

57. Return to an Order of the House of Commons, dated the 7th December, 1910, for a copy of all correspondence between the Government of Canada or the Right Honourable, the First Minister, and the government of Manitoba, or the Premier of Manitoba, referring to the demand of Manitoba for an extension of boundaries and an increase in subsidy. Presented 14th December, 1910.—*Mr. Staples.*
Printed for sessional papers.

58. Memorandum respecting the finances of the National Battlefields Commission, as on the 31st March, 1910. Presented 15th December, 1910, by Hon. William Paterson.
Printed for sessional papers.

CONTENTS OF VOLUME 23—*Continued.*

58*a*. Report from The National Battlefields Commission. Presented 15th December, 1910, by Rt. Hon. Sir Wilfrid Laurier.. .. ..*Printed for sessional papers.*

58*b*. Return to an Address of the Senate dated 24th February, 1911, calling for a copy of the last report made to the Government by the members of the Quebec Battlefields Commission. Presented 10th March, 1911.—*Hon. Mr. Landry.. .. ..Not printed.*

58*c*. Return to an Order of the Senate dated 12th January, 1911, for copies of all Orders in Council relating to the appointment of members of the "National Battlefields Commission" of the Province of Quebec, as well as a statement showing the sums received by the said Commission, the sources whence received, the interest thereon, the expenses incurred, the nature of such expenses, distinguishing what has been paid for the acquisition of lands, the balance in hand, and the approximate cost, with the nature of the expenses to be incurred to attain the end which the Commission has proposed for itself. Presented 21st March, 1911.—*Hon. Mr. Landry. Not printed.*

58*d*. Return to an order of the Senate dated 23rd February, 1911, for a statement showing the number of gold, silver, and bronze medals, which the Quebec Battlefields Commission has caused to be struck in commemoration of the three hundredth anniversary of the foundation of the City of Quebec, the cost of each of these series of medals, the names of the persons to whom, or the institutions to which, gold medals, silver medals, and bronze medals have been given. Presented 28th April, 1911.—*Hon. Mr. Landry.. .. ..Not printed.*

59 Return to an address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, Boards of Trade or other bodies and corporations, favouring or asking for a treaty or reciprocity with the United States; and also if all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the Government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 15th December, 1910.—*Mr. Foster.. .. .. ..Not printed.*

59*a*. Supplementary return to an address of the House of Commons, dated 7th December 1910, for a copy of all petitions, memorials and resolutions from individuals, Boards of Trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 11th January, 1911.—*Hon. Mr. Foster. Not printed*

59*b*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, Boards of Trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the Government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 3rd February, 1911.—*Hon. Mr. Foster.. .. ..Not printed.*

59*c*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, Boards of Trade or other bodies and corporations, favouring os asking for a treaty of reciprocity with the United States; and also of all similar documents

CONTENTS OF VOLUME 23—*Continued.*

protesting against or unfavourable to the same, and a copy of all correspondence had with the Government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 8th February, 1911.—*Hon. Mr. Foster*.. .. ..*Not printed.*

59*d*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, boards of trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 27th February, 1911.—*Hon. Mr. Foster.*, *Not printed.*

59*e*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, Boards of Trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the Government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 8th March, 1911.—*Hon. Mr. Foster.* *Not printed.*

59*f*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, Boards of Trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the Government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 14th March, 1911.—*Hon. Mr. Foster.* *Not printed.*

59*g*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, Boards of Trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the Government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 22nd March, 1911.—*Hon. Mr. Foster.* *Not printed.*

59*h*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, Boards of Trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the Government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 27th March, 1911.—*Hon. Mr. Foster.* *Not printed.*

59*i*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, boards of trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents pro-

CONTENTS OF VOLUME 23—*Continued.*

testing against or unfavourable to the same, and a copy of all correspondence had with the Government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 28th March, 1911.—*Hon. Mr. Foster.*
Not printed.

59*j*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, Boards of Trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 28th March, 1911.—*Hon. Mr. Foster.*
Not printed.

59*k*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, Boards of Trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the Government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Prsented 31st March, 1911.—*Hon. Mr. Foster.*
Not printed.

59*l*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, Boards of Trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 7th April, 1911.—*Hon. Mr. Foster.*
Not printed.

59*m*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, Boards of Trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the Government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 19th April, 1911.—*Hon. Mr. Foster.*
Not printed.

59*n*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, Boards of Trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the Government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 19th April, 1911.—*Hon. Mr. Foster.*
Not printed.

59*o*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all petitions, memorials and resolutions from individuals, boards of trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States, and also of all similar documents pro-

CONTENTS OF VOLUME 23—*Continued.*

testing against or unfavourable to the same, and a copy of all correspondence had with the Government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 2nd May, 1911.—*Hon. Mr. Foster.*
Not printed.

59*p*. Further supplementary return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all memorials and resolutions from individuals, Boords of Trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the Government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 5th May, 1911.—*Hon. Mr. Foster.*
Not printed.

59*q*. Return to an Order of the House of Commons, dated 19th April, 1911, for a Return showing what duties are imposed by Australia, New Zealand, Norway, France, Spain, Sweden, Switzerland, Austria-Hungary, Japan, Argentine, Venezuela and Russia, respectively, upon each of the articles included in the reciprocity agreement between the United States and Canada.

And also, a statement showing the import prices in 1910 on which duty was collected on the butter, eggs cheese, salt, beef, bacon, hams, mutton, lamb, pork in brine and other meat products detailed, barley, beans, oats, peas, wheat, hay, flaxseed, green apples, and animals, imported from the above named countries. Presented 8th May, 1911.—*Hon. Mr. Foster*.. .. ..*Not printed.*

59*r*. Return to an order of the House of Commons, dated 8th May, 1911, for a Return showing, taking the latest Return of Commerce and Navigation of the United States as a basis, the advantage Canada will have in the United States market over her principal competitors, under the construction given at Washington by the United States Court of Customs Appeals on April 10th, 1911, regarding the favoured nation clause, by which the competitors of Canada in the United States market are denied the privileges granted to Canada by the reciprocal agreement in regard to the importation into the United States of the following goods and articles, namely: (*a*) Mackerel pickled or salted; (*b*) Herring, pickled; (*c*) Cod, Haddock, Hake and Pollock, dried, smoked, salted or pickled; (*d*) all other kinds of fish, salted or pickled; (*e*) Fish oils: (*f*) Butter; (*g*) Cheese; (*h*) Cattle; (*i*) Horses; (*j*) Oats; (*k*) Coke; (*l*) Mineral Waters; (*m*) Rolled Iron or Steel Sheets, coated with zinc, tin or other metal; (*n*) Mica; (*o*) Flax seed; (*p*) Beans and dried peas; (*q*) Onions; (*r*) Potatoes; (*s*) other vegetables in natural state.

Also showing the present rate of duty in the United States on the above goods and articles; the rate under the proposed reciprocal agreement of the said goods and articles; the value of goods; and the amount of duty collected on goods imported from said competitors on the trade of said year, which will be free under the agreement on goods from Canada. Presented 16th May, 1911.—*Mr. Sinclair..Not printed.*

59*s*. Further supplementary Return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all memorials and resolutions from individuals, Boards of Trade or other bodies and corporations, favouring or asking for a treaty of reciprocity with the United States; and also of all similar documents protesting against or unfavourable to the same, and a copy of all correspondence had with the Government, or any member thereof, concerning reciprocity with the United States, since the 1st January, 1910. Presented 19th May, 1911.—*Hon. Mr. Foster...Not printed.*

CONTENTS OF VOLUME 23—*Continued.*

59*f*. Statements relative to (1) The yearly imports, quantity and value, for the past six years into Canada from, respectively, Australia, New Zealand, Denmark, Holland, Belgium, France, Argentine Republic and the United States, of wheat, oats, horses, cattle, sheep, lambs, mutton, beef, eggs, butter, cheese, fowl, vegetables and fruit.

(2) The average prices of butter and of eggs in London, England, for the past five years in comparison with the prices, respectively, in Eastern Provinces, in Montreal, in Toronto, in Minneapolis, in Chicago, in Detroit, in Buffalo, in Boston and in New York. Presented 28th July, 1911, by Hon. S. A. Fisher.. .. .. ..*Not printed.*

60. Return of orders in council passed between the 1st of November, 1909, and the 30th September, 1910, in accordance with the provisions of section 5 of the Dominion Lands Survey Act, Chapter 21, 7-8 Edward VII. Presented 11th January, 1911, 1911, by Hon. Frank Oliver.. .. ..*Not printed.*

60*a*. Return of Orders in Council which have been published in the *Canada Gazette* and in the British Columbia *Gazette*, between 1st November, 1909, and 30th September, 1910, in accordance with provisions of subsection (*d*) of section 38 of the regulations for the survey, administration, disposal and management of Dominion Lands within the 40-mile railway belt in the province of British Columbia. Presented 11th January, 1911, by Hon. Frank Oliver.. .. ..*Not printed.*

60*b*. Return called for by section 77 of the Dominion Lands Act, chapter 20 of the Statutes of Canada, 1908, which is as follows:—

"77. Every regulation made by the Governor in Council, in virtue of the provisions of this Act, and every order made by the Governor in Council, authorizing the sale of any land or the granting of any interest therein, shall have force and effect only after it has been published for four consecutive weeks in the *Canada Gazette*, and all such orders or regulations shall be laid before both Houses of Parliament within the first fifteen days of the session next after the date thereof, and such regulations shall remain in force until the day immediately succeeding the day of prorogation of that session of Parliament, and no longer, unless during that session they are approved by resolution of both Houses of Parliament." Presented 11th January, 1911, by Hon. Frank Oliver.. .. ..*Not printed.*

61. Return of Orders in Council passed between the 1st November, 1909, and the 30th September, 1910, in accordance with the provisions of the Forest Reserve Act, sections 7 and 13 of Chapter 56, Revised Statutes of Canada. Presented 11th January, 1911, by Hon. Frank Oliver.. .. ..*Not printed.*

62. Return to an order of the House of Commons, dated the 7th December, 1910, for a copy of Sir John Thompson's memorandum on the question of the rights of fishing in the bays of British North America, prepared for the use of the British Plenipotentiaries at Washington in 1888 , and a copy of the Treaty agreed to and approved by the President. Presented 11th January, 1911.—*Hon. Mr. Foster.*

Printed for sessional papers.

63. Return to an Address of the House of Commons, dated 7th December, 1910, for a copy of any memorials, correspondence, &c., between His Excellency the Governor General and the Colonial Office, or between any member of the government, and the foreign consuls general in Canada, relative to the status of the latter, at official functions, such as the vice-regal drawing room. Presented 11th January, 1911.—*Mr. Sproule.*

Printed for sessional papers.

CONTENTS OF VOLUME 23—*Continued.*

64. Return to an order of the House of Commons, dated 6th December, 1910, for a return showing:—1. What newspapers or companies publishing newspapers in the cities of Montreal and Quebec have directly or indirectly received sums from the Government of Canada for printing, lithographing, binding or other work, between the 31st March, 1910, and the 15th November, following.

2. What is the total amount paid to each of said newspapers or companies between the dates above stated. Presented 11th January, 1911.—*Mr. Monk.. .. ..Not printed.*

65. Return to an Address of the House of Commons, dated 7th December, 1910, for a copy of all Orders in Council, correspondence, papers, maps or other documents, which passed between the Government of Canada or any member thereof, and the Government of Quebec, or any member thereof, or any other parties on their behalf, or between the Government of Canada and the Government of Ontario, or any members thereof, regarding the extension of the boundaries of the province of Quebec, as set forth in an Order in Council dated 8th July, 1896, establishing a conventional boundary, therein specified. And also any correspondence, papers, documents, &c., that may have passed between the aforesaid governments or members thereof, relative to the passing of an Act to confirm and ratify the aforesaid conventional boundary, which was passed in 1898. Presented 11th January, 1911.—*Mr. Sproule.*

Printed for sessional papers.

66. Return to an Order of the House of Commons, dated 14th December, 1910, for a Return showing the names of manufacturers in Canada of turned kiln dried maple boot, last and shoe last blocks, in the rough, for making manufacturers' boot and shoe lasts. Presented 11th January, 1911.—*Mr. Hughes.. .. ..Not printed.*

67. Return to an Order of the House of Commons, dated 5th December, 1910, for a copy of all correspondence, reports, memorials, surveys and other papers in the possession of the Government, and not already brought down, regarding the oyster industry of Canada; also a copy of all correspondence, reports and other papers regarding the ownership and control of Oyster beds and of barren bottoms suitable for Oyster culture, and regarding the consolidating of the ownership with the control and regulation of such beds and barren bottoms, and vesting the same in the hands of the Dominion Government; olso a copy of all correspondence, reports, recommendations and other papers relating to the leasing or sale of such beds or barren bottoms or of portions of them, for the purpose of Oyster culture or cultivation. Also o copy of all correspondence and reports relating to the culture, cultivation asd conservation of oysters and other mollusks. Presented 11th January, 1911.—*Mr. Warburton.*

Printed for sessional papers.

68. Order of the House of Commons, dated 5th December, 1910, for a copy of all reports, evidence, correspondence, and other documents relating to an investigation into irregularities in the life saving station at Clayoquot, mentioned on page 353 of the Report of the Department of Marine and Fisheries for 1909 and 1910, sessional paper No. 22. Presented 11th January, 1911.—*Mr. Barnard.. .. ..Not printed.*

69. Return to an Order of the House of Commons, dated 14th December, 1910, for a Return showing how many employees of the custom house at Montreal have left the service since the 1st July, 1896, up to this date, with their names, duties, salaries and ages, respectively, and date of their leaving; the names, ages, salaries and duties of those who have replaced them, the date of their entry and their present salaries. Presented 11th January, 1911.—*Mr. Wilson (Laval).. .. ..Not printed.*

CONTENTS OF VOLUME 23—*Continued.*

69*a*. Return to an Order of the House of Commons, dated 8th February, 1911, for a Return showing the full names of the permanent or temporary employees appointed at Montreal since the 1st of January, 1904, in the Post Office Department, the Customs, Inland Revenue and Public Works; the age and place of residence of these employees at the time of their appointment, the dates and nature of changes, promotions or increases of salary granted these employees since their appointment. Presented 28th April, 1911.—*Mr. Gervais*.. .. ..*Not printed.*

70. Return to an Address of the House of Commons, dated 7th December, 1910, for a Return showing what arrangements have been made with foreign countries by the Governor General in Council under the provisions of the Customs Tariff Act of 1907, without reference to Parliament. Presented 11th January, 1911.—*Mr. Ames*.. ..*Not printed.*

71. Return to an Order of the House of Commons, dated 14th December, 1910, for a Return showing the total expenses in connection with the surrender of St. Peter's Indian Reserve, including moving the Indians to new reserve, sale of lands, and all the expense made necessary by the surrender. Presented 11th January, 1911.—*Mr. Bradbury*.. .. ..*Not printed.*

71*a*. Return to an Order of the House of Commons, dated 14th December, 1910, for a copy of all correspondence with Rev. John McDougall and all instructions given to him regarding St. Peter's Indians and their reserve; and of Rev. John McDougall's report of his investigations at St. Peter's Indian Reserve. Presented 11th January, 1911. —*Mr. Bradbury*.. .. ..*Not printed.*

71*b*. Supplementary Return to an Order of the House of Commons, dated 14th December, 1910, for a Return showing the total expenses in connection with the surrender of St. Peter's Indian Reserve, including moving the Indians to new Reserve, sale of lands, and all the expense made necessary by the surrender. Presented 18th January, 1911. —*Mr. Bradbury*.. .. ..*Not printed.*

71*c*. Return to an Address of the House of Commons, dated 11th January, 1911, for a copy of all correspondence, offers, agreements, orders in council, reports, records, regulations, or other papers or documents, relating to the grant or surrender to one Merrill, or some other person or corporation, of the concession or right to bore for and acquire natural gas, upon or under the Six Nation Reserve, at or near Brantford, Ontario; together with a statement of all monies paid for said concession or right, and also of all monies subsequently received by the Six Nation Indians, or by the government on their behalf for such concession or rights. Presented 2nd February, 1911.—*Mr. Osler*.. .. ..*Not printed.*

72. Return to an Order of the House of Commons, dated 14th December, 1910, for a copy of all correspondence, reports, documents and papers relating to the strike of the employees of the Cumberland Coal and Railway Company, Limited, not previously brought down. Presented 11th January, 1911.—*Mr. Rhodes*.. .. ..*Not printed.*

72*a*. Return to an Order of the House of Commons, dated 5th December, 1910, for a copy of the agreement of settlement of the late strike between the Grand Trunk Railway Company and the conductors and brakemen, and of all correspondence, documents and papers relating thereto, or in consequence thereof, between the said parties, or between either and any person or persons authorized or professing to act for either, or between the Government or any Minister or Deputy Minister or other person on its behalf, and said parties, or either of them, or any person authorized or professing to act for them or either of them before, during, or since said strike. Presented 11th January, 1911.—*Mr. Northrup*.. .. ..*Not printed.*

CONTENTS OF VOLUME 23—*Continued.*

72*b*. Return to an Order of the House of Commons, dated 25th January, 1911, for a copy of all correspondence, documents and papers relating to the late strike on the Grand Trunk Railway between the said railway and the striking conductors and trainmen, or between either and any person or persons authorized or professing to act for either, or between the Government or any Minister or Deputy Minister, or any one on his behalf, and either of said parties or any on professing to act on behalf of either, since the 29th day of November, A.D., 1910, and particularly all documents, papers, correspondence and agreements relating to the reinstatement of any of the men who had been on strike, and the appointment of Judge Barron. Presented 2nd February, 1911.—*Mr. Northrup*.. .. ..*Not printed.*

73. Return to an Order of the House of Commons, dated 7th December, 1910, for a Return implementing for the year 1910, the information brought down in answer to an Order of the House of Commons referring to the operations of the mint, dated January 19, 1910. Presented 11th January, 1911.—*Hon. Mr. Foster*.. .. ..*Not printed.*

74. Supplementary Return to an Order of the House of Commons, dated 24th November, 1909, for a return showing the total amounts paid by the government in each year since 1896, for all printing, advertising and lithographing done outside of the Government Printing Bureau; the total amount so paid by each department of the Government or such purposes during each year; the names and addresses of each individual, firm or corporation to whom any such moneys have been so paid, and the total amount paid to each such individual, firm or corporation in each year since 1896. What portion of the said sums, if any, so paid since 1896 was expended after public advertisement, tender and contract, to whom such tenders were awarded, whether to the lowest tender in each case, what portion was expended otherwise than by public advertisement, tender and contract, and to whom it was paid in each instance. Presented 11th January, 1911.—*Mr. Armstrong*.. .. ..*Not printed.*

74*a*. Return to an Order of the Senate dated 1st February, 1911, for a Return showing year by year, from July 1st, 1896 up to date, the amounts paid to the Montreal *Herald*, by the several departments of the Government of this country. Presented 8th March, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

74*b*. Return to an Order of the Senate dated 25th January, 1911, for the production of a statement showing, year by year, from the 1st July, 1896 up to this date, the sums of money paid to the newspaper, *Le Soleil*, by each of the different departments of the Government of this country. Presented 8th March, 1911.—*Hon. Mr. Landry.* *Not printed.*

74*c*. Return to an Order of the Senate dated 25th January, 1911, for the production of a statement showing, year by year, the sums of money paid the newspaper *La Vigie*, of Quebec, by each of the different departments of the Government of this country from the founding of that newspaper up to this date. Presented 8th March, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

74*d*. Return to an Order of the Senate dated 1st February, 1911, for a Return showing, year by year, from 1st July, 1896, up to date, the amounts paid to *La Presse* of Montreal, by the several departments of the Government of this country. Presented 8th March, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

74*e*. Return to an Order of the Senate dated 1st February, 1911, for a Return showing, year by year, from July 1st, 1896, up to date, the amounts paid to *La Presse* of Montreal, by the several departments of the Government of this country. Presented 8th March, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

CONTENTS OF VOLUME 23—*Continued.*

74*f*. Return to an Order of the Senate dated 24th January, 1911, for a Return showing, year by year, from the 1st July, 1896, up to date, the amounts paid to the paper *Le Canada*, of Montreal, by each of the departments of the government of this country. Presented 8th March, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

74*g*. Return to an Order of the Senate dated 31st January, 1911, showing, year by year, from July the 1st, 1896, up to date, the amounts paid to the Martineau Company by the several departments of the country. Presented 4th April, 1911.—*Hon. Mr. Landry.*
Not printed.

74*h*. Return to an Order of the Senate dated the 31st January, 1911, showing, year by year, from 1st July, 1896, up to date, the amounts paid to Mr. Jean Drolet, of Quebec, by the several departments of the country. Presented 4th April, 1911.—*Hon. Mr. Landry.*
Not printed.

74*i*. Return to an Order of the Senate dated 3rd February, 1911, showing, year by year, from the 1st July, 1896, to this date, the sums of money paid to O. Picard and Sons, of Quebec, by the different departments of the Government of this country. Presented 4th April, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

74*j*. Return to an Order of the Senate dated 24th January, 1911, showing, year by year from July 1, 1896, up to date, the amounts paid to Mr. De Courcy, contractor, by each of the departments of this country. Presented 4th April, 1911. *Hon. Mr. Landry.*
Not printed.

74*k*. Return to an Order of the House of Commons, dated the 23rd February, 1911, for a Return showing:—1. All sums of money paid by the Government since 31st March last to *Le Canada* newspaper of Montreal or the publishers of the same respectively, for advertising or printing, for lithographing or other work; and directly or indirectly for copies of the newspaper.

2. Is the said newspaper executing any work of any kind for the Government at present.

3. Have tenders been called publicly for any of the work done by said newspaper for the government during the past year. Presented 6th April, 1911.—*Mr. Monk.*
Not printed.

74*l*. Supplementary Return to an Order of the Senate dated 24th January, 1911, for a Return showing year by year, from 1st July, 1896, up to date, the amounts paid to Mr. De Courcy, contractor, by each of the departments of this country. Presented 27th April, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

74*m*. Return to an Order of the House of Commons, dated 15th May, 1911, for a Return showing how much was paid by the Government to the proprietors or publishers of the Essex *Record*, a daily and weekly paper published in Windsor, Ontario, for printing and advertising, during the fiscal year ending 31st March, 1907, 1908, 1909, 1910 and 1911. Presented 18th July, 1911.—*Mr. Boyce*.. .. ..*Not printed.*

75. Return to an Order of the House of Commons, dated 12th December, 1910, for a Return showing the average value for duty in 1896 and in 1910, respectively, of the unit of each article or commodity enumerated in the schedules of the Customs Act, on which in both years an ad valorem duty was payable. Presented 12th January, 1911.—*Mr. Borden (Halifax)*.. .. ..*Not printed.*

CONTENTS OF VOLUME 23—*Continued.*

76. Return to an Order of the House of Commons, dated 14th December, 1910, for a Return showing all applications made to the Government during the period of agreement with Japan concerning Japanese immigrants, to admit such immigrants for special purposes, together with a copy of all correspondence in connection with the same. Presented 12th January, 1911.—*Mr. Taylor (New Westminster).. .. .. ..Not printed.*

76*a*. Return to an Order of the House of Commons, dated 7th December, 1910, for a Return giving a list of the special immigration agents appointed by the government since the 31st March, 1909, in what portions of Great Britain and Irelond, the European Continent, or other country they are severally located, their addresses when they were so appointed the date of their appointment in each case their respective salaries and expenses, and any commissions that may have been paid to each or any since their appointment. Presented 12th January, 1911.—*Mr. Wilson (Lennox and Addington).. .. ..Not printed.*

76*b*. Return to an Order of the House of Commons, dated 11th January, 1911, for a Return showing the number of immigrants who have come to Canada since the 31st March last up to the present time, the countries from which they came, the number from each such country, the number of males and the number of females in each case, the number under fourteen years of age, between fourteen and twenty-one years, between twenty-one and forty, and between forty and sixty in each case, their occupations before coming to Canada, their religion, their destination in Canada, their occupation when they arrived at such destination; also the number who have been prevented from landing, and the number deported. Presented 6th February, 1911.—*Mr. Wilson (Lennox and Addington).. .. ..Not printed.*

76*c* Return to an Order of the Senate dated 24th January, 1911, calling for the production in detail of the accounts and claims fyled at the Department of the Interior or the Immigration Office, Quebec, by Mr. Jacques Dery; restaurant keeper, during the navigation season of 1910. Presented 7th February, 1911.—*Hon. Mr. Landry.*
Not printed.

76*d*. Return to an Order of the Senate dated 20th January, 1911, calling for the report received by the Immigration Department on the subject of the complaints brought against Mr. Jacques Dery, the keeper of the restaurant established in the immigration buildings at Quebec, and also of the correspondence exchanged and the inquiry held by the immigration agent with regard to the overcharges by the restaurant keeper, and of the refund which he had to make to immigrants of the price obtained for goods of bad quality. Presented 7th February, 1911.—*Hon. Mr. Landry.*
Not printed.

76*e*. Return to an Order of the Senate dated 25th January, 1911, for the production of a complaint, signed by a large number of persons employed at the Immigration Office and Immigration buildings at Quebec and addressed to the agent of the Department at that place, against Mr. Jacques Dery, the restaurant keeper, and also of the reply of the latter. Presented 7th February, 1911.—*Hon. Mr. Landry.. .. .. ..Not printed.*

76*f*. Return to an Order of the Senate dated 25th January, 1911, that an Order of this House do issue for the production of a letter dated 1st June, 1910, written by Mr. L. Stein, of Quebec, addressed to Mr. W. D. Scott, Superintendent of Immigration. Presented 10th February, 1911.—*Hon. Mr. Landry.. .. ..Not printed.*

CONTENTS OF VOLUME 23—*Continued.*

76*g*. Return to an Order of the House of Commons, dated 3rd April, 1911, for a Return showing the itemized accounts, vouchers, statements, reports and other papers relating to the salary and expenses of and payments to W. O. Creighton, farmer delegate to Great Britain in 1910. Presented 28th April, 1911.—*Mr. Stanfield*.. .. ..*Not printed*

76*h*. Return to an Order of the House of Commons, dated 3rd April, 1911, for a Return showing all itemized accounts, vouchers, statements, reports and other papers relating to the salary of and payments to W. A. Hickman. immigration agent to Great Britain in 1902 and 1903. Presented 28th April, 1911.—*Mr. Stanfield*.. .. ..*Not printed.*

77. Return to an Order of the House of Commons, dated 5th December, 1910, for a Return showing:—1. The estimated quantity of each class of material required for the construction.

2. The rates or prices agreed upon and the estimated cost of each class of material, based on rates on accepted tender.

3. The total estimated cost based on these quantities and rates in each case of the several bridges let to contract during the fiscal year ended March 31, 1910, referred to on pages 3 and 4 of the Sixth Annual Report of the Commissioners of the Transcontinental Railway.

4. A copy of the specifications and contract in each case, the number of the contract and the name of the contractor.

5. The number of bridges yet to be let to contract, location and character, and the estimated quantity of the different kinds of material in each case.

6. Why these bridges have not been let to contract and when contracts will probably be entered into as to these.

7. The bridges let to contract before March 31, 1909, identified by locality, name of each contractor and number, the estimated cost of each of these bridges at the time the contract was let, based on contract prices, the changes made in the plans, specifications or contracts if any, and claims or allowances for alterations or extras, if any, the percentage of the work done, the payments made to date, the amounts retained as contract reserve, and the ascertained or estimated amount required to complete in each case.

8. The bridges that have been completed, identified as above, the estimated cost at the time of awarding the contract, the nature and extent of changes in plans, specifications, or contract, if any, the increase or decrease of cost thereby occasioned, and the actual total cost of each of those bridges. Presented 13th January, 1911.—*Mr. Lennox*.. .. ..*Not printed.*

77*a*. Return to an Order of the House of Commons, dated 5th December, 1910, for a copy of the Tender and contract of Haney, Quinlan & Robertson for construction of locomotive and other shops about six miles east of Winnipeg, and the total estimated cost based on contract prices. Also a copy of the several other tenders sent in and a statement of the total estimated cost based upon each of these tenders as moneyed out at the time of awarding the contract. Presented 13th January, 1911.—*Mr. Lennox*.. .. ..*Not printed*

77*b*. Return to an Order of the House of Commons, dated 11th January, 1911, for a Return showing as to each contract district of the National Transcontinental Railway between Moncton and Winnipeg, respectively, what was the original departmental estimate of quantities of solid rock, broken stone, earth, sand, &c., and the quantities of each kind of excavation, as above, already paid for. Presented 24th January, 1911.—*Mr. Ames*.. .. ..*Not printed.*

CONTENTS OF VOLUME 23—*Continued.*

77*c*. Return to an Order of the House of Commons, dated 11th January, 1911, for a Return showing in all cases where finished structures on the National Transcontinental Railway, have differed materially, to an extent involving a difference in cost of more than $10,000, from the original standard plans; the original estimated cost of the structure; the cost according to altered plans; the nature of the change; the name of the resident engineer, and of the contractor or sub-contractor; the reason, if any, given for the alteration of plans; and a copy of the correspondence exchanged thereon between the headquarters staff and the engineer on the ground. Presented 24th January, 1911.—*Mr. Ames*.. .. ..*Not printed.*

77*d*. Return to an Order of the House of Commons, dated 11th January, 1911, for a Return showing the clause in the standard contract on the National Transcontinental Railway having reference to train hauled filling, with a statement showing what amounts have been paid to date, and to whom, for services of this nature. Presented 24th January, 1911.—*Mr. Ames*.. .. ..*Not printed.*

77*e*. Return to an Order of the House of Commons, dated 11th January, 1911, for a Return showing what amounts to date have been paid on force account to each and to all contracts connected with the National Transcontinental railway, setting forth the district affected thereby. Presented 24th January, 1911.—*Mr. Ames*.. ..*Not printed.*

77*f*. Return to an Order of the House of Commons, dated 11th January, 1911, for a Return showing all cases where in construction work on the National Transcontinetal Railway a richer mixture of concrete was used than that indicated in the standard specification, to an extent affecting the cost of the work to the amount of $5,000 or more; also the original estimated cost and the actual cost in each of such cases. Presented 24th January, 1911.—*Mr. Ames*.. .. ..*Not printed.*

77*g*. Return to an Order of the House of Commons, dated 11th January, 1911, for a Return showing a list of the members of the engineering staff who have been dismissed, or have resigned or left the service of the National Transcontinental Railway Commission since 1904, with position formerly held, the date of leaving, and the assigned cause in each instance. Presented 7th February, 1911.—*Mr. Ames*.. .. ..*Not printed.*

77*h*. Return to an order of the House of Commons, dated 26th January, 1911, for a Return showing:—1. In those cases in which an agreement was come to last autumn between Mr. Killiher and Mr. Gordon as to overbreak on the eastern Division of the Transcontinental Railway, what quantities of material, and of what class, and what sums of money were taken from or added to the progress Estimates.

2. In the cases where measurements had to be made, have they been made, and with what result. Presented 17th February, 1911.—*Mr. Lennox*.. .. .. ..*Not printed.*

77*i*. Return to an Order of the House of Commons, dated 11th January, 1911, for a Return showing, in respect of all cases on the National Transcontinental Railway, where the original specifications have not been adhered to; the estimated cost as per original plan; the actual or estimated cost as per amended plan; the name of the contractor and the resident engineer, and the reason given by the latter for such change. Presented 24th February, 1911.—*Mr. Ames*.. .. ..*Not printed.*

77*j*. Return to an Order of the House of Commons, dated 16th January, 1911, for a Return showing what will have been the total expenditure upon, in connection with or in consequence of, the National Transcontinental Railway up to the 31st of December, 1910, and what amount it is estimated will be required to complete and fully equip the said road between Winnipeg and Moncton. Presented 27th February, 1911.—*Mr. Ames*.. .. ..*Not printed.*

CONTENTS OF VOLUME 23—*Continued.*

77*k*. Interim Report of the Commissioners of the Transcontinental Railway for the nine months ended December 31, 1910. Presented 27th February, 1911, by Hon. G. P. Graham.. .. .. .

CONTENTS OF VOLUME 23—*Continued.*

77*o*. Return to an Order of the House of Commons, dated 13th March, 1911, for a Return prepared upon the lines of Sessional Papers No. 46*i* of the 26th April, 1909, relating to the Eastern Division of the Transcontinental Railway, showing the actual expenditure upon each of the scheduled items upon each of the 21 contracts for construction of this division, down to the latest estimate made upon each contract, and the estimated quantity of work to be done and material to be furnished as to each of these items, and the estimated cost to complete the contract in each case. Presented 10th April, 1911.—*Mr. Lennox*.. .. ..*Not printed.*

77*p*. Return to an Address of the Senate dated 23rd March, 1911, for a copy of the Order in Council dated 23rd June, 1910, transferring from the Government to the National Transcontinental Railway Commission, the spur line between the Quebec bridge and the city of the same name. Presented 19th April, 1911.—*Hon. Mr. Landry.*
Not printed.

78. For approval by the House under section 17 of the Yukon Act, Chapter 63 of the Revised Statutes of Canada, 1906, a copy of an ordinance made by His Excellency the Governor General in Council, in virtue of the provisions of Section 16 of the said Chapter 63, on the 9th day of December, 1909, and intituled: "An ordinance to rescind an Ordinance respecting the imposition of a tax upon ale, porter, beer or lager beer imported into the Yukon Territory. Presented 13th January, 1911, by Hon. Frank Oliver.. .. ..*Not printed.*

79. Return under Section 88 of the Northwest Territories Act, Chapter 62, Revised Statutes of Canada. Presented 16th January, 1911, by Hon. Frank Oliver.. .. ..*Not printed.*

80. Return to an Order of the House of Commons, dated 5th December, 1910, for a copy of all correspondence between the mover and any other persons, corporations and municipal as well as other public bodies, and the Department of Railways and Canals, respecting the reconstruction and alteration of the Canadian Pacific Railway Company's bridge across the St. Lawrence river at Lachine, P.Q. Presented 16th January, 1911.—*Mr. Monk*.. .. ..*Not printed.*

81. Report of the Commissioner, Dominion Police Force, for the year 1910. Presented 17th January, 1911, by Sir Allen Aylesworth.. .. ..*Not printed.*

82. Return to an order of the House of Commons, dated 7th December, 1910, for a copy of all correspondence exchanged between the government and the Phœnix Bridge Company in connection with the payment by said company of $100,000 in discharge of claims *re* contract. Presented 16th January, 1911.—*Mr. Ames*.. .. .. ..*Not printed.*

83. Return to an order of the House of Commons, dated 14th March, 1910, for a return showing the number of accidents to trains of the I.C.R. for ten months, from 1st April, 1908, to 31st December, 1908; the number of persons killed or injured in each of such accidents for ten months, from 1st April, 1908, to 31st December, 1908; and the cost of each of such accidents to the I. C. R., respectively, for repairs, property destroyed, compensation to passengers, and for compensation to shippers for freight and baggage. Presented 16th January, 1911.—*Mr. Stanfield*.. .. ..*Not printed.*

83*a*. Return to an order of the House of Commons, dated 14th March, 1910, for a return showing the sumber of accidents to trains on the I. C. R. between 1st April, 1909, and present date, and the location and particulars of each; the number of persons killed or injured in each of such accidents since 1st April, 1909, to date; and the cost of each of such accidents to the I. C. R., respectively, for repairs, property destroyed, compensation to passengers, and for compensation to shippers for freight and baggage. Presented 16th January, 1911.—*Mr. Stanfield*.. .. ..*Not printed.*

CONTENTS OF VOLUME 23—*Continued.*

83*b*. Return to an order of the House of Commons, dated 5th December, 1910, showing all data, statements, estimates, recommendations and reports with regard to an Intercolonial railway renewal equipment account, and as to the initiation of such account and the operation thereof to the present time.

2. A copy of all correspondence with the Auditor General and other persons in regard thereto.

3. A copy of all correspondence, inquiries and investigations by or on behalf of the Auditor General as to the need for such account, and as to the sufficiency or otherwise of moneys carried to such account, and also as to the application of such moneys.

4. The same returns as to the maintenance of rails account; and the same returns as to a maintenance of bridges account, also as to any other items of maintenance, and as to any recommendations regarding the adoption of such accounts. Presented 16th January, 1911.—*Mr. Barker*.. .. ..*Not printed.*

83*c*. Return to an order of the Senate dated 4th May, 1910, calling for the following information:—

1. Were tenders asked for, in 1908 and 1909, for the purchase of railway sleepers for the use of the Intercolonial railway, and were contracts awarded to the lowest tenderer?

2. Who had these contracts, and what is the name of each tendered, and also the amount of each tender?

3. Did the Department of Railways and Canals, in 1908 and 1909, award any contracts whatsoever for the purchase of the said sleepers and what price was paid to each contractor, and who had these contracts?

4. In 1908 and 1909, did the Department of Railways and Canals ask for tenders for the purchase of sleepers made of spruce, white, gray and yellow, as well as of birch, ash, poplar, &c.?

5. What quantity of these sleepers, for each kind of wood, was accepted and paid for in 1908 and 1909, and does the department propose to continue the system of purchasing these kinds of wood?

6. Who bought these sleepers of spruce, birch, ash, poplar, &c., and who gave the orders to receive these kinds of sleepers, and who received them and stamped them for the Intercolonial railway?

7. In 1909, did the department ask for tenders for sleepers of cedar, cyprus and hemlock? If so, who had these contracts and were these contracts granted to the lowest bidders, and what quantities were actually furnished by each contractor?

8. What quantity of sleepers has been furnished up to this date—
   (*a*) by the contractors for New Brunswick; and
   (*b*) by the contractors for Nova Scotia and for the province of Quebec, respectively?

9. Did the government by order in council authorize Messrs. Pottinger, Burpee or Taylor of Moncton, to purchase sleepers of spruce of all kinds and dimensions, and to cause these kinds of sleepers to be distributed in the district of Quebec, and notably in the district of River du Loup and Isle Verte?

10. What price did the department pay for the sleepers of spruce, hemlock, cedar, birch and poplar, &c.? Who is the contractor therefor? Who received and inspected the said sleepers?

11. Does the department know that these sleepers are absolutely unfit to be used in a railway, and that these sleepers are at the present time distributed along the Intercolonial railway to be used upon the main track?

CONTENTS OF VOLUME 23—*Continued.*

12. How much a carload does the freight of sleepers sent from New Brunswick cost in the district of Quebec? Presented 3rd February, 1911.—*Hon. Mr. Landry.* *Not printed.*

84. Return to an order of the House of Commons, dated 11th January, 1911, for a return showing the respective quantities of each of the staple varieties of fish landed by Canadian Atlantic fishermen yearly, since 1870, and the respective yearly values thereof. Presented 16th January, 1911.—*Mr. Jameson*.. .. ..*Not printed.*

85. Return to an order of the House of Commons, dated 7th December, 1910, for a copy of all letters, telegrams, correspondence, resolutions, memorials, reports, and all other papers in the possession of the government, not already brought down, regarding otter, beaver, or steam trawling, and the operations of the trawlers *Wren* and *Coquette* in the waters of the Northumberland strait, or elsewhere, in Nova Scotia. Presented 16th January, 1911.—*Mr. Chisholm (Antigonish)*.. .. ..*Not printed.*

86. Return to an order of the House of Commons, dated 7th December, 1910, for a return showing the revenue of the post offices of Acton Vale, Upton and St. Pie, in the county of Bagot, province of Quebec, since the year 1903 up to 1910 inclusively. Presented 17th January, 1911.—*Mr. Monk*.. .. ..*Not printed*

86*a*. Return to an order of the House of Commons, dated 16th January, 1911, for a copy of all instructions or communications from the Department of Public Works or any officer thereof, or the minister of public works, to the chief architect, or any other architect, with respect to the preparation of plans for the construction of a post office building at Parrsboro, Nova Scotia, and all other post office buildings or public buildings to be used wholly or in part by the Post Office Department, for which votes have been passed during the period from 1st January, 1908, to 31st December, 1910. Presented 20th April, 1911.—*Mr. Rhodes*.. .. ..*Not printed.*

87. Return to an address of the Senate dated 22nd April, 1910, for:—

1. Copies of all orders in council or of every order of the Department of Justice and of the Department of Public Works, and of all the correspondence exchanged between the government, the Departments of Justice and Public Works, the Bank of Montreal, the firm of Carrier & Lainé, of Lévis, and all other persons, on the subjects of—

(*a*) The acquisition by the government of the property of the firm of Carrier & Lainé, at the time of the sale thereof by the sheriff in 1908;

(*b*) the subsequent expropriation, for purposes of public utility, of the same property, which had fallen into the hands of the bank of Montreal;

(*c*) its definite purchase from the Bank of Montreal by the government;

(*d*) the appointment of an agent to represent the government at the sale by the sheriff;

(*e*) the appointment of experts for proceeding with the expropriation of the lands in question;

2. Copies of all reports submitted, directly or indirectly, to the government, or in its possession, by the experts hereinbefore mentioned, or by the arbitrators to whom the Bank of Montreal and the firm of Carrier & Lainé had submitted their differences, or by the various advocates or agents acting in the name and in the interests of the government.

3. Copies of the various contracts entered into between La Banque du Peuple and the People's Bank of Halifax in 1905, between the government and the bank of Montreal, in 1909, between the government and Mr. Ernest Cann, who had become the

CONTENTS OF VOLUME 23—*Continued.*

lessee of the government, for a period of thirty years, of the lands and buildings formerly the property of Carrier & Lainé.

4. Copies of all documents whatsoever and of a correspondence relating to the various transactions aforesaid, and also a statement showing all the sums of money paid by the government with respect to such transactions, with the names of the persons to whom such sums were paid, and the amounts paid to each of them, and for what particular object. Presented 11th January, 1911.—*Hon. Mr. Landry.*

Not printed.

87*a*. Supplementary return to an address of the Senate dated 22nd April, 1910, for:—

1. Copies of all orders in council or of every order of the department of justice and of the department of public works, and of all the correspondence exchanged between the government, the department of justice and public works, the bank of Montreal, the firm of Carrier & Lainé, of Lévis, and all other persons, on the subject of—

(*a*) The acquisition by the government of the property of the firm of Carrier & Lainé. at the time of the sale thereof by the sheriff in 1908;

(*b*) the subsequent expropriation, for purposes of public utility, of the same property, which had fallen into the hands of the Bank of Montreal;

(*c*) its definite purchase from the bank of Montreal by the government;

(*d*) the appointment of an agent to represent the government at the sale by the sheriff;

(*e*) the appointment of experts for proceeding with the expropriation of the lands in question;

2. Copies of all reports submitted, directly or indirectly, to the government, or in its possession, by the experts hereinbefore mentioned, or by the arbitrators to whom the bank of Montreal and the firm of Carrier & Lainé had submitted their differences, or by the various advocates or agents acting in the name and in the interests of the government.

3. Copies of the various contracts entered into between La Banque du Peuple, and the People's Bank of Halifax in 1905, between the government and the bank of Montreal, in 1909, between the government and Mr. Ernest Cann, who had become the lessees of the government, for a period of thirty years, of the lands and buildings formerly the property of Carrier & Lainé.

4. Copies of all documents whatsoever and of all correspondence relating to the various transactions aforesaid. and also a statement showing all the sums of money paid by the government with respect to such transactions, with the names of the persons to whom such sums were paid, and the amounts paid to each of them, and for what particular object. Presented 18th January, 1911.—*Hon. Mr. Landry.*

Not printed.

87*b*. Further supplementary return to an address of the Senate dated 22nd April, 1910, for

1. Copies of all orders in council or of every order of the Department of Justice and of the Department of Public Works, and of all the correspondence exchanged between the government, the Departments of Justice and Public Works, the Bank of Montreal, the firm of Carrier & Lainé, of Lévis, and all other persons, on the subjects of—

(*a*) The acquisition by the government of the property of the firm of Carrier & Lainé, at the time of the sale thereof by the sheriff in 1908;

(*b*) the subsequent expropriation, for purposes of public utility, of the same property, which had fallen into the hands of the bank of Montreal;

(*c*) its definite purchase from the Bank of Montreal by the government;

CONTENTS OF VOLUME 23—*Continued.*

(*d*) the appointment of an agent to represent the government at the sale by the sheriff;

(*e*) the appointment of experts for proceeding with the expropriation of the lands in question;

2. Copies of all reports submitted, directly or indirectly, to the government, or in its possession, by the experts hereinbefore mentioned, or by the arbitrators to whom the Bank of Montreal and the firm of Carrier & Lainé had submitted their differences, or by the various advocates or agents acting in the name and in the interests of the government.

3. Copies of the various contracts entered into between La Banque du Peuple and the People's Bank of Halifax in 1905, between the government and the Bank of Montreal in 1909, between the government and Mr. Ernest Cann, who had become the lessee of the government, for a period of thirty years, of the lands and buildings formerly the property of Carrier & Lainé.

4. Copies of all documents whatsoever and of all correspondence relating to the various transactions aforesaid, and also a statement showing all the sums of money paid by the government with respect to such transactions, with the names of the persons to whom such sums were paid, and the amounts paid to each of them, and for what particular object. Presented 27th January, 1911.—*Hon. Mr. Landry.*

Not printed.

87*c*. Supplementary return to an address of the Senate dated 22nd April, 1910, for copies:—

1. Copies of all orders in council or of every order of the Department of Justice and of the Department of Public Works; and of all the correspondence exchanged between the government, the Departments of Justice and Public Works, the Bank of Montreal, the firm of Carrier & Lainé, of Lévis, and all other persons, on the subjects of—

(*a*) The acquisition by the government of the property of the firm of Carrier & Lainé, at the time of the sale thereof by the sheriff in 1908;

(*b*) the subsequent expropriation, for purposes of public utility, of the same property, which had fallen into the hands of the bank of Montreal;

(*c*) its definite purchase from the Bank of Montreal by the government;

(*d*) the appointment of an agent to represent the government at the sale by the sheriff;

(*e*) the appointment of experts for proceeding with the expropriation of the lands in question;

2. Copies of all reports submitted, directly or indirectly, to the government, or in its possession, by the experts hereinbefore mentioned, or by the arbitrators to whom the Bank of Montreal and the firm of Carrier & Lainé had submitted their differences, or by the various advocates or agents acting in the name and in the interests of the government.

3. Copies of the various contracts entered into between La Banque du Peuple and the People's Bank of Halifax in 1905, between the government and the Bank of Montreal in 1909, between the government and Mr. Ernest Cann. who had become the lessee of the government, for a period of thirty years, of the lands and buildings formerly the property of Carrier & Lainé.

4. Copies of all documents whatsoever and of all correspondence relating to the various transactions aforesaid, and also a statement showing all the sums of money paid by the government with respect to such transactions, with the name of the persons to whom such sums were paid, and the amounts paid to each of them, and for what particular object. Presented 7th February, 1911.—*Hon. Mr. Landry.*

Not printed.

CONTENTS OF VOLUME 23—*Continued.*

87*d* Return to an order of the Senate dated 9th March, 1911, for a return of copy of the contract entered into between the Bank of Montreal and the People's Bank of Halifax, in 1905, in connection with the financial situation and with the obligations of the firm of Carrier-Laine, a copy of which contract was handed over to the government at the time of the financial transactions concluded between the Bank of Montreal and the government in 1909. Presented 4th April, 1911.—*Hon. Mr. Landry.*
Not printed.

88. Return to an address of the Senate dated 24th November, 1910, for copies of all orders in council, memoranda or other correspondence respecting the resignation of the present Lieutenant Governor of the province of Quebec, the apopintment of his successor, the application for leave of absence, and the appointment of an administrator during the absence from the country of His Honour Sir Pantaleon Pelletier. Presented 11th January, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

88*a*. Return to an address of the Senate dated 8th February, 1911, for a copy of the order in council extending, for a period of two months, the leave of absence already obtained by Sir Pantaleon Pelletier, together with copy of all the correspondence on the subject between the government, His Honour the Lieutenant Governor of the province of Quebec, and the present administrator of the said province. Presented 14th February, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

89. Return to an order of the House of Commons, dated 16th January, 1911, for a copy of all correspondence, letters, telegrams, reports and papers of every description between the liquidators of the Charing Cross Bank or of A. W. Carpenter or anyone on their behalf, and any member of the government, or official thereof, regarding the affairs of the Atlantic, Quebec and Western railway, the Quebec Oriental railway, or the new Canadian Company, limited. Presented 18th January, 1911.—*Mr. Ames.*
Not printed.

90. Return to an order of the House of Commons, dated 14th December, 1910, for a return showing how many wireless telegraph stations are owned by the government where are they located, the cost of each, and the revenue derived from each; what stations are leased, to whom they are leased, the amount of rental received each year and the period covered by said lease. Presented 18th January, 1911.—*Mr. Armstrong.*
Not printed.

91. Return to an order of the House of Commons, dated 15th March, 1910, for a return showing the names of all persons who have been fined for breach of fisheries regulations in the coast waters of the counties of Pictou and Cumberland, Nova Scotia, and Westmorland, New Brunswick, during the years 1907, 1908 and 1909, together with a full statement of the penalties inflicted, moneys collected, and fines or portion thereof remitted, if any, in each case. and for a copy of all instructions issued, reports, correspondence and documents relating in any manner thereto. Presented 18th January, 1911.—*Mr. Rhodes*.. .. ..*Not printed.*

91*a*. Return to an order of the House of Commons, dated 11th January, 1911, for a return showing the names of all persons who have been fined for breach of fishery regulations in the coast waters of Prince Edward Island since the year 1900 up to this date, together with a statement of the penalties inflicted, moneys collected, and fines or portions thereof remitted, in each case; and for a copy of all instructions issued, reports, correspondence and documents relating in any manner thereto. Presented 6th March, 1911.—*Mr. Fraser*.. .. ..*Not printed.*

CONTENTS OF VOLUME 23—*Continued.*

92. Return to an order of the House of Commons, dated 16th January, 1911, for a copy of the mailing list, and names of all parties to whom the Department of Labour mailed or otherwise sent copies of the *Labour Gazette* during the year 1910, and of the names of all correspondents that report to the department on labour topics for the purposes of the *Labour Gazette.* Presented 18th January, 1911.—*Mr. Currie (Simcoe).*
Not printed.

93. Return to an order of the House of Commons, dated 7th December, 1910, for a copy of all correspondence and other papers and documents that have passed between the government and any party or parties during the past year in connection with the dredging of the Napanee river; also any instruction given by the minister in connection therewith? Presented 18th January, 1911.—*Mr. Wilson (Lennox and Addington).. .. .. .

CONTENTS OF VOLUME 23—*Concluded.*

94*a*. Return to an order of the House of Commons, dated 26th January, 1911, for a return giving the names of the lighthouse keepers on the St. Lawrence, between Quebec and Montreal, since the 12th April, 1887, and what yearly salary has been paid them respectively since that date. Presented 27th February, 1911.—*Mr. Blondin.*
Not printed.

95. Return to an address of the House of Commons, dated 5th December, 1910, a copy of a Report by Mr. W. T. R. Preston, Commissioner of Trade and Commerce in Holland *re* the establishment of a Netherland loan company in Canada; of all communications between the Department of Trade and Commerce and any other department of the government and Mr. Preston on the subject matter of this report; a copy of all correspondence between Mr. Preston and any person or persons in Holland regarding proposed operations of a Dutch Loan Company in Canada, and a copy of correspondence or communications of any nature whatsoever between the government or the department with any persons relating to this question. Presented 19th January, 1911.—*Mr. Monk*.. .. .. .

CONTENTS OF VOLUME 24—*Continued.*

96*a*. Return to an order of the House of Commons, dated 7th December, 1910, for a copy of all applications, correspondence, and other documents in reference to sections 11, 12, 14, 22 24, 28, 30, 32, 34, and 36 in township 10, range 22, west of the 4th meridian. Presented 1st February, 1911.—*Mr. Wallace*.. .. ..*Not printed.*

96*b*. Return to an order of the House of Commons, dated 8th February, 1911, for a copy of all letters, telegrams and correspondence between the Department of the Interior or any of its officials and Mr. J. Krenzer, or their solicitor, or one Mr. Wolf, and of all reports of the officials of the said department respecting the south half section 28, township 27, range 18, west of the 2nd principal meridian, and also all correspondence, letters and telegrams between the department and one Thomas Greenway or his brother respecting the said lands; and all correspondence between the department and its officials respecting the said lands; and all papers, reports, correspondence and documents put in the files of the department, since the 1st of April, in relation to the dispute between said Krenzer and said Greenway. Presented 22nd February, 1911.—*Mr. Staples*.. .. ..*Not printed.*

97. Minutes of conference held at Washington the 9th, 10th, 11th and 12th January, 1911, as to the application of the award delivered on the 7th September, 1910, in the North Atlantic coast fisheries arbitration to existing regulations of Canada and Newfoundland. Presented 19th January, 1911. by Sir Allen Aylesworth.

Printed for both distribution and sessional papers.

97*a*. Copy of order in council approved by His Excellency the Governor General in Council on the 21st January, 1911, relating to changes in the fishery regulations under section 54 of "The Fisheries Act," chapter 45 of the revised statutes of Canada, 1906, in conformity to the agreement made at the conference held at Washington, January, 1911 Also dspatch from Mr. Bryce to Lord Grey. Presented 25th January, 1911, by Hon. L. P. Brodeur... .. ..*Printed for both distribution and sessional papers.*

97*b*. (1) Copy of Hague Tribunal Award concerning Atlantic fisheries given 7th September, 1910;

(2) Extracts from the special fishery regulations for the province of Quebec;

(3) Protocol 30 containing statements of the acts of Newfoundland and Canada objected to by the United States authorities.

On motion of Mr. Brodeur, it was ordered, That Rule 74 be suspended, and that the foregoing papers in connection with the "Hague Tribunal Award," be printed forthwith, and put under the same cover as the documents the printing of which was ordered at the sitting of the House on the 25th January, 1911. Presented 27th January, 1911, by Hon. L. P Brodeur.

Printed for both distribution and sessional papers.

98. Return to an order of the House of Commons, dated 11th January, 1911, for a copy of all memorials, petitions and requests received by the government since last session advocating the enlargement of the Welland canal, as well as all memorials, petitions, resolutions, &c., favouring the construction of the Montreal and Georgian Bay canal. Presented 20th January, 1911.—*Mr. Hodgins*.. .. ..*Not printed.*

98*a*. Return to an order of the House of Commons, dated 11th January, 1911, for a copy of the lease made between the government and the Canadian Light and Power Company relating to the Beauharnois canal. Presented 20th January, 1911.—*Mr. Lortie.*

Not printed.

CONTENTS OF VOLUME 24—*Continued.*

98*b*. Return to an order of the House of Commons, dated 23rd January, 1911, for a return showing in detail:—1. All sums paid by the concessionaires or grantees of the Beauharnois canal as rental or royalties upon the rights conveyed to them by the Crown on the Beauharnois canal, or paid by their assigns in the enjoyment of the said rights, since the concession.

2. Of all sums paid or expended by the government upon the said canal since the date of the said concession.

3. Of all sums actually due the Crown by the grantees or assigns for the use of the said canal or in connection therewith. Presented 7th February, 1911.—*Mr. Monk.*
Not printed.

98*c*. Supplementary return to an order of the House of Commons, dated 11th January, 1911, for a copy of all memorials, petitions and requests received by the government since last session advocating the enlargement of the Welland canal, as well as all memorials, petitions, resolutions, &c., favouring the construction of the Montreal and Georgian Bay canal. Presented 10th February, 1911.—*Mr. Hodgins*.. ..*Not printed.*

98*d*. Return to an order of the House of Commons, dated 1st February, 1911, for a copy of all leases, agreements and contracts made with any person, persons, company or corporations, granting by way of lease or otherwise, any water powers on or along the Trent Valley canal; together with any correspondence in connection with same. Presented 9th March, 1911.—*Mr. Roche*.. .. ..*Not printed.*

98*e*. Return to an address of the House of Commons, dated 23rd January, 1911, for a copy of all correspondence concerning the lease or alienation of the Beauharnois canal, of all reports called for by the government and made concerning the said alienation by experts, officers of the departments or others, of all orders in council respecting said alienation and of the deed or deeds between the Crown and the concessionaires embodying the said lease or alienation and respecting also any transfers of their rights and privileges by the original grantees. Presented 14th March, 1911.—*Mr. Monk*.. .. ..*Not printed.*

99. Return to an order of the House of Commons, dated 12th December, 1910, for a statement showing the amounts paid by the several government departments since 1st January, 1908, to the following law firms, or to any member thereof, and what has been in each case the nature of the service rendered; Messrs. Dandurand, Hibbard & Company, Montreal; Stewart, Cox & McKenna, Montreal; Smith, Markay & Company, Montreal; Hibbard, Boyer & Gosselin, Montreal. Presented 23rd January, 1911.—*Mr. Reid (Grenville)*.. .. ..*Not printed.*

100. Return to an order of the House of Commons, dated 14th December, 1910, for a return showing the cost of the Senate of Canada for each year since the fiscal year 1896. under the headings of number of senators, indemnity, travelling expenses, printing, staff, and contingencies. Presented 23rd January, 1911.—*Hon. Mr. Foster.*
Not printed.

101. Return to an order of the House of Commons, dated 16th January, 1911, for a return showing the names of the United States consuls or consular officers in the Dominion, the districts over which each has consular authority, the scale of fees which is exacted by them for certification of exports to the United States and the number of certified lots of goods exported under certificate during the year 1910. Presented 24th January, 1911.—*Mr. Rhodes*.. .. ..*Not printed.*

CONTENTS OF VOLUME 24—*Continued.*

102. Return to an order of the House of Commons, dated 7th December, 1910, for a copy of all customs entries made at Vancouver, British Columbia, for goods entered free of duty by each of the following parties during each of the years 1901, 1902, 1903, 1904, 1905, 1906, 1907, 1908, 1909 and 1910:—Robert Kelly, by himself, agent, or broker for him; Kelly. Douglas & Company, or agent, or broker, for them; and by any or all of the departments of the Dominion government; also by any other person, firm or firms, or broker, having been allowed to make free entry at Vancouver, British Columbia, during above years, declared as for supply to the Dominion government. Presented 24th January, 1911.—*Mr. Barnard*.. .. ..*Not printed.*

102*a*. Return to an order of the House of Commons, dated 23rd January, 1911, for a return showing the average value for duty in 1896 and 1910, respectively, of the unit of each article or commodity enumerated in the schedules of the Customs Act, on which an ad valorem duty was payable together with the rate of duty, the amount on which duty was paid, and the amount of duty paid for each year, with the totals, respectively. Presented 13th February, 1911.—*Hon. Mr. Foster*.. .. ..*Not printed.*

103. Return to an order of the House of Commons, dated 7th December, 1910, for a return showing the names, respective ages, when appointed, and pay received, by the sessional employees of the House of Commons. Presented 25th January, 1911.—*Mr. Sproule*.. .. ..*Not printed.*

103*a*. Return to an order of the House of Commons, dated 13th February, 1911, for a return showing the names and addresses of all sessional employees of the House of Commons, beginning with the session immediately subsequent to the elections of 1896, and for each year succeeding, to and including the present session, their duties in each case, their home addresses, their salaries, their transfers in each and every case to either other appointments of the sessional staff or to permanent employment in any department, the dates of each such appointment or transfer, upon whose recommendation each such appointment was made, their dismissals, if any, and the reasons therefor. Presented 28th March, 1911.—*Mr. Sharpe (Ontario)*.. .. .. ..*Not printed.*

104. Return to an order of the House of Commons, dated 5th December, 1910, for a return showing the date of the opening and closing of parliament for each year from 1896 to 1910, and the number of days the House and Senate was in session for each of these years. Presented 27th January, 1911.—*Hon. Mr. Foster*.. .. ..*Not printed.*

105. Return to an order of the House of Commons, dated 23rd January, 1911, for a copy of all letters, telegrams, correspondence, petitions and communications referring in any manner to the establishment or maintenance of the mail route from Athol post office to South Athol, county of Cumberland, N.S Presented 27th January, 1911.—*Mr. Rhodes*.. .. ..*Not printed.*

106. Return to an order of the House of Commons, dated 11th January, 1911, for a copy of all correspondence, telegrams or memoranda had between this government, or any member thereof, and the provincial government of Alberta and Saskatchewan, or either of them, or any of their members, in reference to securing control by such provincial governments of the lands, timber, water powers, coal and other minerals, or any of the natural resources which exist within the respective boundaries of said provinces. Presented 27th January, 1911.—*Mr. Herron*.. .. ..*Not printed.*

106*a*. Return to an order of the House of Commons, dated 13th February, 1911, for copies of any correspondence between the government of the Dominion, or any member thereof, and the provincial governments of Alberta and Saskatchewan, or either of

CONTENTS OF VOLUME 24—*Continued.*

them, or any of their members, in reference to securing control by such provincial governments of the lands, timber, water powers, coal and other minerals, or any of the natural resources which exist within the respective boundaries of said provinces, other than school lands. Presented 20th February, 1911.—*Mr. Lake.. ..Not printed.*

107. Return to an order of the House of Commons, dated 23rd January, 1911, for a copy of all correspondence between the Minister of Justice and the Attorney General of Nova Scotia in respect to the proposed change in the constitution of the Admiralty Court for that province. Presented 30th January, 1911.—*Mr. McKenzie.. .. .. Not printed.*

108. Return to an address of the House of Commons, dated 5th December, 1910, for a copy of the proclamation of the Governor in Council naming a day for the coming into force of an Act intituled "An Act to amend the Railway Act, 1903," chapter 31 of the Statutes of Canada of 1904 as provided for by Section 2 of that Act. Presented 30th January, 1911.—*Mr. Lennox.. .. ..Not printed.*

109. Return to an address of the House of Commons, dated 11th January, 1911, for a statement giving a concise history of the negotiations in regard to reciprocal trade carried on since 1900 between the governments of Canada and of the Australian Commonwealth, together with a copy of official telegrams upon the same subject exchanged between the two governments, or between the official representatives thereof, since the Imperial Conference of 1907. Presented 31st January, 1911. —*Mr. Ames.. .. ..Not printed.*

109a. Tariff relations between the United States and the Dominion of Canada, 1911. Presented 1st February, 1911, by Hon. W. S. Fielding.. .. ..*Not printed.*

109*b*. Tariff relations between the United States and the Dominion of Canada, correspondence and statements, 1911. Presented 6th February, 1911, by Hon. W. S. Fielding. *Printed for both distribution and sessional papers.*

109*c*. Return to an order of the House of Commons, dated 27th February, 1911, for a return showing respectively, the total trade, the imports, the exports for each year from 1846 to 1876, both inclusive, between the British North American possessions, except Newfoundland, and the United Kingdom, the United States of America and other countries respectively. Presented 14th March, 1911.—*Mr. Borden.. .. ..Not printed.*

110. Return to an order of the House of Commons, dated 16th January, 1911, for a copy of all correspondence between the Finance Department, or any of its officers ,or any members of the government, and any persons or corporotions with reference to the incorporation of the Farmer's Bank, or to circumstances in connection therewith. Presented 1st February, 1911.—*Hon. Mr. Foster.. .. ..Not printed.*

110*a*. Return to an order of the House of Commons, dated 23rd January, 1911, for a copy of all correspondence between the government or any member thereof, or any official of the Department of Finance, and any person or association, with reference to the conduct and affairs of the Farmer's Bank since the date of its organization. Presented 1st February, 1911.—*Hon. Mr. Foster.. .. ..Not printed.*

110*b*. Return to an order of the House of Commons, dated 23rd January, 1911, for a copy of the full report and finding of the curator of the Farmer's Bank, up to the time of his appointment as liquidator of the same by the shareholders for the requisition of which, authority is given to the Minister of Finance by Section 122 of the Bank Act. Presented 1st February, 1911.—*Hon. Mr. Foster.*

Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 24—*Continued.*

110*c*. Return to an address of the House of Commons, dated 16th January, 1911, for a copy of all applications, petitions, letters, telegrams and other documents and correspondence, and all orders in council and certificates, relating to or connected with the establishment of the Farmer's Bank of Canada and its operations. Presented 1st February, 1911—*Mr. Taylor (Leeds)*.

Printed for both distribution and sessional papers.

111. Return to an order of the House of Commons, dated 7th December, 1910, for a return showing the total cost to date of wharves at North Bay, Burks Falls and Maganatawan, Ontario; the name, date of appointment and salary of wharfinger in each case; the schedule of fees charged to public or others for use of wharf in each case; and a detailed statement of receipts for each wharf for the years 1907, 1908, 1909, giving name of party paying and for what. Presented 2nd February, 1911.—*Mr. Arthurs.*

Not printed.

112. Return to an order of the House of Commons, dated 23rd January, 1911, for a copy of all correspondence since the 1st January, 1909, with the Department of Justice or any officers of that department, making or supporting request for increase of pay to employees of the penitentiary at New Westminster; and of all reports or recommendations in that connection made by any officer of the department. Also a copy of all reports made during the period indicated, by the grand jury at New Westminster with reference to the conditions at said penitentiary. Presented 3rd February, 1911. *Mr. Taylor (New Westminster)*.. .. ..*Not printed.*

113. Report of proceedings between the Farmers' Delegation and the Prime Minister and members of the government held in the House of Commons chamber on the 16th December, 1910, with corresponding preliminary to the meeting. Presented 6th February, 1911, by Rt. Hon. Sir Wilfrid Laurier.

Printed for both distribution and sessional papers.

113*a*. Report of proceedings of the deputation of fruit and vegetable growers and the Prime Minister and members of the government held in the House of Commons on the tenth February instant. Presented 21st February, 1911, by Rt. Hon. Sir Wilfrid Laurier.

Printed for both distribution and sessional papers.

113*b*. Memorandum presented by the meat packers of Ontario and Quebec at a meeting held with members of the government on Monday, February 13, 1911. Presented 21st February, 1911, by Rt. Hon. Sir Wilfrid Laurier.

Printed for both distribution and sessional papers.

114. Return to an address of the Senate dated 12th January, 1911, for a copy of the order in council appointing His Honour Judge Jetté, administrator of the province of Quebec during the absence of Sir Pantaléon Pelletier, as well as a copy of any instruction whatsoever in connection with such appointment. Presented 19th January, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

115. Return to an address of the Senate dated 17th January, 1911, calling for dates of publication and distribution to members of parliament of the English and French editions of the debates of the Senate and of the House of Commons from the year 1900 to date. Presented 25th January, 1911.—*Hon. Mr. Landry*.. .. .. ..*Not printed.*

115*a*. Return to an order of the Senate dated 17th January, 1911, for a copy of a return showing, year by year, from 1900, up to the present day, the date of the publication and distribution to members of parliament:—

1. Of the English edition of the Journals of the Senate.

CONTENTS OF VOLUME 24—*Continued.*

2. Of the French edition of the same.
3. Of the English edition of the Journals of the House of Commons.
4. Of the French edition of the same. Presented 14th February, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

115b. Return to an order of the Senate dated 17th January, 1911, for a copy of a return showing, year by year, from 1900, up to the present day, the date of the publication and distribution to members of parliament:—
1. Of the English edition of the Jounrnals of the Senate.
2. Of the French edition of the same.
3. Of the English edition of the Journals of the House of Commons.
4. Of the French edition of the same. Presented 14th February, 1911.—*Hon. Mr Landry*.. .. ..*Not printed.*

116. Return to an address of the Senate dated 17th January, 1911, for a statement of the number of applications for and number of divorces granted by the parliament of Canada from 1894 to 1910 inclusive. Presented 24th January, 1911.—*Hon. Mr. McSweeny*.. .. ..*Not printed.*

117. Return to an address of the Senate dated 22nd April, 1910, showing the expenses incurred, and the date of each of the payments made by the government for the electric installation in each of the rooms of the immigration officer at Quebec during the years 1908 and 1909. Presented 31st January, 1911.—*Hon. Mr. Landry.*
1911.—*Mr. Lennox*.. .. ..*Not printed.*

118. Return to an order of the House of Commons, dated 16th January, 1911, for a return showing what amount the government paid Mr. F. H. Chrysler, K.C., for professional services between May, 1896, and 31st March, 1909, and what amount during the financial year ending 31st March, 1910; what amount since 31st March, 1910; what amount is now due by the government to Mr. Chrysler; and in what transactions or cases Mr. Chrysler is now engaged in for the government. Presented 6th February. 1911.—*Mr. Blain*.. .. ..*Not printed.*

119. Return to an order of the House of Commons, dated 25th January, 1911, for a statement showing:—
1. How much wheat was exported from Canada for the crop years ending 31st August, 1908, 1909 and 1910.
2. How much wheat was exported from Canada through United States ports during 1908, 1909 and 1910, naming said ports, and amount exported from each port.
3. How many terminal grain elevators are there at Port Arthur and Fort William, and what is the name of each.
4. How much grain was shipped through each elevator at Port Arthur and Fort William during each year 1908, 1909 and 1910, and what are the names of the elevators respectively.
5. How much wheat was exported from Canada during each crop year 1908, 1909 and 1910, not passing through the terminal elevators at Port Arthur and Fort William.
6. How many men are employed by the government in connection with the terminal elevators at Port Arthur and Fort William, and what is the total salary paid the men per year. Presented 7th February, 1911.—*Mr. Schaffner.*
Printed for sessional papers.

120. Return to an order of the House of Commons, dated 18th January, 1911, for a return showing how many appointments have been made by the government from the con-

CONTENTS OF VOLUME 24—*Continued.*

stituency of South Grey since 1904, their names, to what positions appointed, and the salary or remuneration in each case. Presented 9th February, 1911.—*Mr. Blain.*
Not printed.

120*a*. Return to an order of the House of Commons, dated 25th January, 1911, for a return showing the full names of the permanent and temporary employees appointed at Quebec since the first of January, 1905, in the following departments: Post Office, Customs, Inland Revenue and Public Works; the age and place of residence of each of these employees at the time of their appointment, the dates and nature of changes, promotions or increases of salary granted them since their appointment. Presented 15th February, 1911.—*Mr. Lachance*.. .. ..*Not printed.*

120*b*. Supplementary return to an order of the House of Commons, dated 18th January, 1911, for a return showing how many appointments have been made by the government from the constituency of South Grey since 1904, their names, to what positions appointed, and the salary or remuneration in each case. Presented 20th February, 1911.—*Mr. Blain*.. .. ..*Not printed.*

120*c*. Return to an order of the House of Commons, dated 23rd January, 1911, for a return showing how many appointments have been made by the government from the constituency of Wentworth since 1904, together with their names, to what positions appointed, and the salary or remuneration in each case. Presented 27th February, 1911.—*Mr. Blaine*.. .. ..*Not printed.*

121. Return to an address dated the 24th November, 1910, for copies of all orders in council, of all decisions rendered by the Military Council or some of its members, and of all correspondence concerning the guard and escort of honour applied for in August and September last on the occasion of the visit in Quebec and Montreal of His Excellency Cardinal Vannutelli. Presented 10th February, 1911.—*Hon. Mr. Landry.*
Not printed.

122. Return to an address of the Senate dated 1st February, 1911, calling for copies of petitions presented by the Quebec Board of Trade, or of the resolutions adopted by it during November and December last, and transmitted to the Right Honourable the Prime Minister of this country, together with all correspondence exchanged on the subject of these resolutions. Presented 7th February, 1911.—*Hon. Mr. Landry.*
Not printed.

123. Return to an order of the House of Commons, dated 11th January, 1911, for a copy of all letters, agreements, telegrams, or memoranda with respect to the application for water-power license on the Elbow river west of Calgary. Presented 13th February, 1911.—*Mr. McCarthy*.. .. ..*Not printed*

123*a*. Return to an order of the House of Commons, dated 18th January, 1911, for a copy of all correspondence had between the government, or any member thereof, and the Municipal Council of the City of Calgary, or any member thereof, regarding the conserving of the water flow of the Elbow river above the intake established by the said city in connection with their water works system. Presented 16th February, 1911.—*Mr. McCarthy*.. .. ..*Not printed.*

124. Return to an order of the House of Commons, dated 26th January, 1911, for a statement showing the amounts paid by the various departments of the government to the Sherwin-Williams Company for paints and other goods in the years 1906, 1907, 1908, 1909 and 1910. Presented 14th February, 1911.—*Mr. Boyce*.. .. .. ..*Not printed.*

CONTENTS OF VOLUME 24—*Continued.*

125. Return to an order of the Senate dated 18th January, 1911, showing:—

1. In 1884, did a federal statute (47 Vict., ch. 78) confirm the legal existence of the Quebec Bridge Company?

2. In 1901, did not another federal statute (1 Edward VII, ch. 81), give birth to a company known as "The Quebec Terminal and Railway Company"?

3. In 1903, after having been, for two years, completely distinct from one another, did not the two above-mentioned companies amalgamate, constituting a new company, to which a federal statute (3 Edward VII, ch. 177) gave the name of "The Quebec Bridge and Railway Company"?

4. Was it not during the same year 1903, that were signed between the Quebec Pridge and Railway Company, the agreements which gave to the government the power to substitute itself to the bridge company and to complete at a certain date the colossal enterprise of the construction of a bridge over the St. Lawrence near Quebec?

5. Was not this substitution of the government to a private company confirmed by federal legislation in 1908 at the time of the adoption by parliament of chapter 59 of 7-8 Edward VII?

6. Under the said legislation, has the government passed an order in council enacting that it take hold of the whole of the undertaking, assets, properties and concessions of the said Quebec Bridge and Railway Company?

7. When was this order in council passed?

8. What composes the whole of the undertaking, assets, properties and concessions of the said company mentioned in the laws?

9. Has any part of the said whole of the undertaking, assets, properties and concessions of the company been transferred to the Grand Trunk Pacific Railway Company, or to the National Transcontinental Commission?

10. What was the part so transferred?

11. Does it comprise the bridge or some of the railway lines from the bridge and ending at the city of Quebec or at some place on the line of the Canadian Pacific railway, on the north, and of the Grand Trunk railway on the south of the river?

12. Are not the construction of the bridge and of the railway lines from the bridge, north and south of the St. Lawrence river, under the exclusive jurisdiction of the government who have kept the entire control thereof? Presented 14th February, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

125*a*. Return to an address of the Senate dated 22nd February, 1911, for a copy of the order in council, dated 17th August, 1908, authorizing the transfer to the government of the Quebec bridge, and of all the assets, franchises and privileges then the property of the Quebec Bridge and Railway Company. Presented 8th March, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

126. Return to an order of the House of Commons, dated 7th December, 1910, for a copy of all papers, reports, valuations, plans, documents, contracts, advertisements, tenders, offers, and letters, relating to the sale and disposition of the property purchased by the government for a barracks site at Toronto, and recently sold by the government, generally known as the Baby Farm or property; and more particularly, all correspondence, valuations or opinions as to the value of the said property, and as to the method of disposal thereof; and also a copy of advertisements, number of insertions, and names of papers in which same appeared, in the possession of the Department of Militia, or any other department of the government. Presented 10th February, 1911.—*Mr. Macdonell*.. .. ..*Not printed.*

CONTENTS OF VOLUME 24—*Continued.*

127. Return to an order of the Senate dated 17th January, 1911, for a return showing, in as many distinct columns:—

1. The names of all departments obliged by law to lay before parliament reports of their annual operations.

2. The date fixed by law for the laying of the said reports before parliament.

3. The date on which the said reports have been laid for the fiscal year ending 31st March, 1910, stating whether it was the English or the French edition which was so laid.

4. The date of the publication and distribution of the French edition of the said reports.

5. The title of the reports which, up to the 15th January, 1911, nine months and a half, after the fiscal year ending the 31st March, 1910, have not yet been published in French.

6. The titles of the reports which, up to the 15th January, 1911, twenty-one months and a half after the fiscal year ending the 31st March, 1909, have not yet been published in French. Presented 16th February, 1911.—*Hon. Mr. Landry.. ..Not printed.*

128. Return to an order of the House of Commons, dated 26th January, 1911, for a return showing the date of incorporation, a copy of the Act of incorporation, and any subsequent amendments thereto, all petitions, correspondence, applications and other papers or data asking for or relating to the grant of subsidy thereto, a copy of all contracts for construction, the subsidies granted and the several payments of the same, the dates of payment and the persons to whom cheques were issued therefor, a copy of engineer's reports and certificates on which payment was authorized in each case, the number of miles completed, the number now being operated, the number of miles still to be finished, the total cost to date and the estimated cost of completion, and the present condition of the road, in the case of the Atlantic, Quebec and Western Railway Company, the Quebec and Oriental R. R. Company and the new Canadian company. Also the shareholders, directors and officers of each of these companies, the capital subscribed and paid up by each subscriber, the amounts paid out each year to directors and officers as fees and salaries, the amount paid for promotion or other expenses, in detail, for each of the above companies. In the case of any mileage operated, the yearly revenues and working expenses. Presented 17th February, 1911.—*Hon. Mr. Foster.. .. ..Not printed.*

128*a*. Supplementary return to an order of the House of Commons, dated 23rd January, 1911, for a return showing the date of incorporation, a copy of the Act of incorporation, and any subsequent amendments thereto, all petitions, correspondence, applications and other papers for data asking for or relating to the grant of subsidy thereto, a copy of all contracts for construction, the subsidies granted and the several payments of the same, the dates of payment and the persons to whom cheques were issued therefor, a copy of engineer's reports and certificates on which payment was authorized in each case, the number of miles completed, the number now being operated, the number of miles still to be finished, the total cost to date and the estimated cost of completion, and the present condition of the road, in the case of the Atlantic, Quebec and Western Railway Company, the Quebec and Oriental R. R. Company and the new Canadian company. Also the shareholders, directors and officers of each of these companies, the capital subscribed and paid up by each subscriber, the amounts paid out each year to directors and officers as fees and salaries, the amount paid for promotion or other expenses, in detail, for each of the above expenses. In the case of any mileage operated, the yearly revenues and working expenses. Presented 17th March, 1911.—*Hon. Mr. Foster.. .. ..Not printed.*

CONTENTS OF VOLUME 24—*Continued.*

128b. Further supplementary return to an order of the House of Commons, dated 23rd January, 1911, for a return showing the date of incorporation, a copy of the Act of incorporation, and any subsequent amendments thereto, all petitions, correspondence, applications and other papers or data asking for or relating to the grant of subsidy thereto, a copy of all contracts for construction, the subsidies granted and the several payments of the same, the dates of payment and the persons to whom cheques were issued therefor, a copy of engineer's reports and certificates on which payment was authorized in each case, the number of miles completed, the number now being operated, the number of miles still to be finished, the total cost to date and the estimated cost of completion, and the present condition of the road, in the case of the Atlantic, Quebec and Western Railway Company, the Quebec and Oriental R. R. Company, and the new Canadian company. Also the shareholders, directors and officers of each of these companies, the capital subscribed and paid up by each subscriber, the amounts paid out each year to directors and officers as fees and salaries, the amount paid for promotion or other expenses, in detail, for each of the above companies. In the case of any mileage operated, the yearly revenues and working expenses. Presented 28th March, 1911.—*Hon. Mr. Foster*.. .. ..*Not printed.*

129. Return to an order of the House of Commons, dated 19th January, 1910, for a return showing in the construction of drill halls or armouries, or the leasing of sites for camps of instruction, in how many and what instances municipalities, regiments, or individuals, have contributed to the cost of the same in the way of concessions, sites, or moneys, and the amount in each case since 1904. Presented 20th February, 1911.—*Mr. Worthington*.. .. ..*Not printed.*

130. Return to an order of the House of Commons, dated 23rd January, 1911, for a copy of all correspondence with the Department of the Interior or any officer thereof in regard to half-breed scrips numbers A. 8931 and A. 9970 issued to Joseph William Malbœuf, together with a copy of all documents in any way relating to the said scrips. Presented 20th February, 1911.—*Mr. Martin (Regina)*.. .. ..*Not printed.*

130a. Return to an order of the House of Commons, dated 18th January, 1911, for a copy of all corrspondence, reports, letters, telegrams and other documents, exchanged between the Right Reverend George Holmes, D.D., of Lesser Slave Lake, or anyone on his behalf, and the Minister of the Interior, or any official or temporary employee of the government, in reference to the issue or application of half-breed scrip. Presented 22nd February, 1911.—*Mr. Ames*.. .. ..*Not printed.*

131. Return to an order of the Senate dated 9th February, 1911, for a return showing the importations by the Dominion from the United States in the year 1910 of the following commodities:—

1. Beef and live cattle. 2. Sheep. 3. Poultry. 4. Ham. 5. Pork. 6. Bacon, 7. Flour. 8. Wheat. 9. Barley.

With the value of the different articles.

Showing also the exportations from the Dominion to the United States of the corresponding products with their relative value. Presented 22nd February, 1911.—*Hon. Mr. Macdonald (B.C.)*.. .. ..*Printed for sessional papers.*

131a. Return to an order of the Senate dated 10th Februry, 1911, for a return showing in as many distinct columns, for the last five years, with an additional column containing the average thereof:—

I. The quality and value of each of the following products.—

CONTENTS OF VOLUME 24—*Continued.*

1. Live stock. 2. Pork and bacon. 3. Potatoes. 4. Eggs. 5. Butter. 6. Cheese. 7. Maple sugar. 8. Fruit. 9. Garden products. 10. Hay. 11. Wheat. 12. Flour. 13. Oats. 14. Other natural products. 15. Agricultural implements.

Of Canadian origin exported to:—(*a*) the United States; (*b*) the English market; (*c*) other countries.

II. The quantity and quality of the same articles, together with the amount of duty collected on each of them for consumption and imported from:—(*a*) the United States; (*b*) the British Isles; (*c*) other countries. Presented 14th March, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

132. Return to on order of the House of Commons, dated 23rd January, 1911, for a copy of all correspondence between the Department of the Interior, or any of its officers, and any other persons, respecting the timber on the Fanny Louise Irwin homestead in the District of Chilliwack, British Columbia, including any instructions to solicitors to issue a writ in Exchequer Court for cancellation of timber rights not reserved in Crown grant of the homestead. Presented 20th February, 1911.—*Mr. Taylor* (*New Westminster*).. .. ..*Not printed.*

133. Return to an order of the House of Commons, dated 18th January, 1911, for a return showing the total acreage of school lands sold in the provinces of Alberta and Saskatchewan in each of the years 1906, 1907 and 1908, with the average prices realized, also a statement of sales of such lands in each said province since 1st of January, 1909, to date, giving the places at which each sale was held and date of sale; the description of the land sold; the upset price at which it was offered and the price realized; and the area of land in each township, in which these school lands are located, that was under cultivation at the time it was decided to sell the school lands therein. Presented 20th February, 1911.—*Mr. McCarthy*.. .. ..*Not printed*

134. Return to an order of the House of Commons, dated 15th December, 1909, for a copy of all papers, letters, telegrams, documents, petitions, reports and correspondence with reference to, or in any way concerning the appointment of a government weigher at Montreal. Presented 20th February, 1911.—*Mr. Armstrong*.. .. ..*Not printed.*

135. Supplementary return to an order of the House of Commons, dated 28th February, 1910, for a return showing the number of persons in the employ of each department of the government during the year 1909 under the following heads: (*a*) civil service employees at Ottawa; (*b*) civil service employees outside of Ottawa; (*c*) in stated and regular employ, but not under the Civil Service Act, giving the distinctive service of each group; (*d*) those in temporary or casual employment, giving the distinctive work of each group, and also showing the total amount paid under each head. Presented 20th February, 1911.—*Hon. Mr. Foster*.. .. ..*Not printed.*

136. Return to an order of the House of Commons, dated 30th January, 1911, for a return showing the total quantity of coal delivered to ship at Pictou, in each year during which the SS. *Stanley* has been engaged in the winter service between Prince Edward Island and Nova Scotia, and the cost thereof.

Also, statements showing the total cost of putting coal aboard; the quantity of freight handled at Pictou, and the total cost of handling such freight. Presented 21st February, 1911.—*Mr. Stanfield*.. .. ..*Not printed.*

136*a*. Return to an order of the House of Commons, dated 30th January, 1911, for a return showing the total quantity of coal delivered to ship at Pictou, in each year during which the SS. *Earl Grey* has been engaged in the winter service between Prince Edward Island and Nova Scotia, and the cost thereof.

CONTENTS OF VOLUME 24—*Continued.*

Also, statements showing the total cost of putting coal aboard; the quantity of freight handled at Pictou, and the total cost of handling such freight. Presented 21st February, 1911.—*Mr. Stanfield*.. .. ..*Not printed.*

136*b*. Return to an order of the House of Commons, dated 30th January, 1911, for a return showing the total quantity of coal delivered to ship at Pictou, in each year during which the SS. *Stanley* has been engaged in the winter service between Prince Edward Island and Nova Scotia, and the cost thereof.

Also, statments showing the total cost of putting coal aboard; the quantity of freight handled at Pictou, and the total cost of handling such freight. Presented 21st February, 1911.—*Mr. Stanfield*.. .. ..*Not printed.*

137. Return to an order of the House of Commons, dated 6th February, 1911, for a copy of the last advertisement for tenders, and the specification and contract or proposed contract for the erection of the Quebec bridge. Presented 21st February, 1911.—*Mr. Lennox*.. .. .. *Not printed.*

137*a*. Return to an address of the House of Commons, dated 5th December, 1910:—

1. For a return showing the contract between the Quebec Bridge and Railway Company and M. P. Davis, dated July 27, 1903, providing for the construction of the lines of railway connecting the Quebec bridge with the city of Quebec and with certain other railways, the tender upon which the contract was based. and the estimated cost at the time of the contract based upon the scheduled quantities and prices.

2. The agreement transferring this undertaking to the government, and of all correspondence and documents in connection therewith and of the order in council of 16th February, 1909, transferring it to the commissioners of the Transcontinental railway.

3. And stating the mileage of the lines of railway embraced in this contract.

4. The sums paid on account by the Quebec Bridge and Railway Company, and the purposes for which it was paid.

5. The amount owing or claimed by the contractor for work done or material supplied up to the time the undertaking was taken over by the government, and the date of taking it over, the amount paid or undertaken to be paid by the government to the company or its members, the estimated amount at that time required to complete the work, the amount the government or commissioners have since paid and the estimated amount yet to be paid.

6. And setting forth the reasons for taking the undertaking out of the hands of the Bridge and Railway Company and for transferring it to the commissioners.

7. Any other sums paid, allowed or assumed for or on account of this company or its members, and the account on which paid, allowed or assumed. Presented 28th March, 1911.—*Mr. Lennox*.. .. ..*Not printed.*

137*b*. Return to an address of the House of Commons, dated 6th March, 1911, for a copy of the order in council appointing, or providing for the appointment of, the engineers to prepare and determine upon plans ond specifications, and superintend the construction of the Quebec bridge, and of all instructions, correspondence, writings and documents, in connection with these appointments, including the two additional engineers; and also a copy of any subsequent orders in council, or any instructions, correspondence, &c., relating to the refusal of any of the engineers to act, or continue in office, or the retirement, or substitutions of engineers. Presented 12th April, 1911. —*Mr. Lennox*.. .. ..*Not printed.*

137*c*. Return to an order of the House of Commons, dated 10th April, 1911, for a copy of all correspondence between the Department of Labour and various labour organizations,

CONTENTS OF VOLUME 24—*Continued.*

or their officers, in connection with the Quebec bridge. Presented 20th April, 1911.—*Mr. Ames*.. .. ..*Not printed.*

137*d*. Return to an order of the Senate dated 24th November, 1910, calling for a copy of all correspondence between the government, some of its members or employees, and the engineers oppointed to prepare the plans of the new bridge to replace the one which collapsed at Quebec in the year 1907. Presented 20th April, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

138. Report of the Ottawa Improvement Commission for the fiscal year ending 31st March, 1910, &c. Presented 21st February, 1911, by Hon. W. S. Fielding. .. .. ..*Not printed.*

139. Fourth Joint Report of the Commissioners for the demarcation of the meridian of the 141st degree of west longitude (Alaskan boundary) appointed in virtue of the first article of the convention between Great Britain and the United States, signed at Washington on the 21st April, 1906. Presented 21st February, 1911, by Rt. Hon. Sir Wilfrid Laurier.. .. ..*Printed for sessional papers.*

140. A return to an address of the Senate dated 20th January, 1911, calling for copies of all orders in council and ordinances, and of all correspondence exchanged between the parties interested in the subject:—

1. Of the lease, before 1896, to Mr. Georges Tanguay of a military property belonging to the government and situated on des Ramparts street at Quebec.

2. Of the requests made by other persons at that time, to purchase or lease the property in question.

3. Of the sale of the same property to the same Georges Tanguay. agreed to by the present government about 1897. Presented 21st February, 1911.—*Hon. Mr. Landry.* *Not printed.*

141. Return to an order of the House of Commons, dated 7th December, 1910, for a statement showing the disposition made by the government during the past year of the following:—public lands, timber limits, mineral areas, water-powers and fishing rights. Presented 22nd February, 1911.—*Mr. Sharpe (Lisgar)*.. .. .. ..*Not printed.*

141*a*. Supplementary return to an order of the House of Commons, dated 7th December, 1910, for a statement showing the disposition made by the government during the past year of the following:—public lands, timber limits, mineral areas, water-powers and fishing rights. Presented 19th May. 1911.—*Mr. Sharpe (Lisgar)*.. ..*Not printed.*

142. Return to an order of the House of Commons, dated 11th January, 1911, for a return showing the concessions granted to Canada by British countries, the products of which may be imposed into Canada under the preferential tariff. Presented 23rd February, 1911.—*Mr. Ames*.. .. ..*Not printed.*

143. Order in council, correspondence, &c., in respect to a resolution of the Legislative Assembly of the province of Saskatchewan, declaring it desirable that the parliament of Canada should create out of the public domain within the province, a suitable land grant for the University of Saskatchewan. Presented 23rd February, 1911, by Rt. Hon. Sir Wilfrid Laurier.. .. ..*Not printed.*

144. Return to an order of the House of Commons, dated 23rd January, 1911, for a return showing:—1. All grants, leases, licenses, and concessions given to individuals or corporations of water power rights or privileges on the Winnipeg river at present in force. 2. The names and descriptions of such power sites. 3. The terms and conditions upon which they are respectively held. 4. The dates upon which these powers

CONTENTS OF VOLUME 24—*Continued.*

or privileges were respectively given. 5. What constitutes forfeiture. 6. What grants, leases or licenses have been forfeited. 7. The general rules and regulations, if any, applying to the giving and holding of the water-powers on this river. 8. The amount of development effected by the grantees or lessees respectively. 9. What title or interest the Dominion claims in the running water, the bed of the river, and the banks thereof. Presented 24th February, 1911.—*Mr Haggart (Winnipeg).*

Not printed.

145. Return to an order of the House of Commons, dated 5th December, 1910, for a return showing the total number of accidents on railways in Canada since 1st April. 1909, and up to date; the number of fatal accidents; the number on each railway, and the causes of the same. Also, the number of accidents on construction work, fatal or otherwise, on the Canadian Northern and the Grand Trunk Pacific railways, and the causes of the same. Presented 24th February, 1911.—*Mr. Smith (Nanaimo).*

Not printed.

146. Return to an order of the Senate dated 24th January, 1911, showing, year by year, from 1st July, 1896, up to date, the amounts paid to Mr. J. B. Laliberté, of Quebec, merchant, by each of the departments of the government of this country. Presented 24th February, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

147. Return to an order of the Senate dated 25th January, 1911, for the production of a statement showing, year by year, from the 1st July, 1896, up to this date, the sums of money paid to the newspaper, the *Daily Telegraph*, of Quebec, by each of the different departments of the government of this country. Presented 24th February, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

148. Return to an order of the Senate dated 26th January, 1911, for a return showing, year by year, since 1st July, 1896, up to date, the amounts paid to Mr. Louis Letourneau, of Quebec, or to the Quebec Preserving Company, by each of the departments of the government of this country. Presented 24th February, 1911.—*Hon. Mr. Landry.*

Not printed.

149. Return to an order of the Senate dated 27th January, 1911, for the production of a return showing, year by year, from the 1st of July. 1896, to this date, the sums of money paid to Messrs. Samson and Filion, of Quebec, merchants, by each of the different departments of the government of this country. Presented 24th February, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed*

150. Return to an order of the Senate dated 27th January, 1911, for the production of a return showing, year by year, from the 1st July, 1896, to this date, the sums of money paid to Mr. C. E. Taschereau, of Quebec, notary, by each of the different departments of the government of this country. Presented 24th February, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

151. Return to an order of the Senate dated 27th January, 1911, for the production of a return showing, year by year, from the 1st July, 1896, to this date, the sums of money paid to Mr. George Tanguay, of Quebec, by each of the different departments of the government of this country. Presented 24th February, 1911.—*Hon. Mr. dry*.. .. ..*Not printed.*

152. Return to an order of the House of Commons, dated 6th February, 1911, for a copy of the curator's reports in the cases of all banks for which curators have been appointed. Presented 27th February, 1911.—*Hon. Mr. Foster*.. .. ..*Not printed*

CONTENTS OF VOLUME 24—*Continued.*

152a. Supplementary return to an order of the House of Commons, dated 6th February, 1911. for a copy of the curators' reports in the cases of all banks for which curators have been appointed. Presented 2nd May, 1911.—*Hon. Mr. Foster.. .. ..Not printed.*

153. Return to an order of the House of Commons, dated 23rd January, 1911, for a copy of the by-laws, rules and regulations of the Canadian Bankers' Association as approved by the Treasury Board and now in effect. Presented 27th February, 1911.—*Hon. Mr. Foster.. .. .. .

CONTENTS OF VOLUME 24—*Continued.*

158*a*. Return to an order of the House of Commons, dated 16th April, 1911, for a return showing the names of all persons in the province of New Brunswick who have received fishing bounties during the year ending 31st March, 1911, with the amount received by each. Presented 2nd May, 1911.—*Mr. Daniel*.. .. ..*Not printed.*

159. Return to an order of the House of Commons, dated 20th January, 1911, for a copy of all reports, correspondence, and documents, not already brought down, including report of survey made in 1909 of the harbour of Cape John and Tatamagouche Bay, in the counties of Pictou and Colchester. in the province of Nova Scotia, relating to the route of the winter steamers between Prince Edward Island and the mainland of Canada, and suggesting or recommending a change or changes on such route, and an increase in the number of trips daily of such winter steamers; also a copy of all similar papers, not already brought down, relating to the route of the summer mail steamers between Charlottetown and the mainland of Canada, and suggesting a change in that route and an increase in the number of trips daily; and also with regard to connecting such suggested route with a point on the Intercolonial railway. Also for a copy of all similar papers, if any, relating to or suggesting the route between Cape Traverse in Prince Edward Island and Cape Tormentine in the mainland, as a route for the winter and summer steamers. Also for a copy of all reports, papers and correspondence relating to additional or improved aids to navigation of the harbour of Charlottetown and entrance thereto and in Tatamagouche bay and harbour. Presented 6th March, 1911.—*Mr. Warburton*.. .. .. ..*Not printed.*

160. Return to an address of the House of Commons, dated 20th February, 1911, for a copy of all correspondence, recommendations, orders in council, or other documents relating to the case of R. E. Curran, a railway mail clerk, who was fatally injured in an accident at Owen Sound, on the 29th May, 1908, and with regard to which application was made for a compassionate grant or allowance to his heirs or family. Presented 7th March, 1911.—*Mr. Macdonell*.. .. ..*Not printed.*

161. Return to an address of the House of Commons, dated 27th February, 1911, for a copy of all orders in council, reports, correspondence, documents and papers touching the dismissal of the sub-collector of customs at Mahone bay, Nova Scotia. Presented 13th March, 1911.—*Mr. Taylor (Leeds)*.. .. ..*Not printed.*

162. Return to an order of the House of Commons, dated 20th February, 1911, for a return showing:—1. The nature of the subsidy which has been granted to the Vancouver Dry Dock Company.

2. The nature of payment of interest or of a guarantee of such subsidy. Presented 13th March, 1911.—*Mr. Barnard*.. .. ..*Not printed.*

163. Return to an order of the House of Commons, dated 6th March, 1911, for a copy of all papers, reports of appraiser, letters and correspondence relating to the appraising and passing the customs of the vessel *Wanda*, owned by one William R. Travers, Toronto, on the 20th October, 1909. Presented 14th March, 1911.—*Mr. Sharpe (Ontario)*.. .. ..*Not printed.*

164. Statement of the affairs of the British Canadian Loan and Investment Company (Limited) for the year ended 31st December, 1910.

Also, a list of the shareholders on 31st December, 1910, in accordance with chapter 57 of 39 Victoria. Presented (Senate) 14th March, 1911, by the Hon. the Speaker.

Not printed

CONTENTS OF VOLUME 24—*Continued.*

165. Return to an order of the House of Commons, dated 27th February, 1911, for a return showing:—

1. How many fisheries officers have been appointed in connection with the Ontario fisheries service within the last year?

2. What are their names, their rank, and the limits territorially of the jurisdiction of each?

3. What is the salary of each, and what is the length of time or duration of such appointments?

4. Do the duties of these officers in any, and in what cases duplicate the services if similar officers appointed by the Ontario legislature?

5. Has anything been done, and what, to prevent the duplication of this service?

6. What is the total revenue derived during the years 1909 and 1910 from fisheries for the province of Ontario, and what was the total expenditure?

7. What will be the total expenditure for the year 1911?

8. Is any, and what, system followed in making appointments to this service as to efficiency. Presented 17th March, 1911.—*Mr. Porter*.. .. ..*Not printed.*

165*a*. Return to an order of the House of Commons, dated 16th February, 1911, for a return showing how many wardens for the protection of fisheries were appointed in Victoria county, N.S., between July and December in the years 1906, 1907, 1909 and 1910.

2. Their names, length of service and amount paid to each. Presented 24th March, 1911.—*Mr. Maddin*.. .. ..*Not printed.*

166. Return to an order of the House of Commons, dated 23rd January, 1911, for a copy of all correspondence between the Post Office Department and any of the officials or other persons, relative to making an allowance for the transportation of letter carriers on the tramway system in New Westminster. Presented 17th March, 1911.—*Mr. Taylor (New Westminster)*.. .. ..*Not printed.*

167. Return to an address of the Senate dated 23rd February, 1911, for a copy of all the documents relating to the case of cholera reported in November last as to the Russian Said Godlieb, to the quarantining of this person, and to his detention until this date on Grosse Isle, with a history of the case. day by day, up to this date. Presented 16th March, 1911.—*Hon. Mr. Landry*.. .. .. *Not printed.*

168. Return to an address of the Senate dated 17th January, 1911, for a statement of the number of divorces granted by the parliament of Canada since 1894 to 1910 inclusive, together with the number of divorces granted by each of the courts of Nova Scotia, New Brunswick, Prince Edward Island, and British Columbia; also the population of each of those provinces according to census of 1901; and the aggregate population of Ontario, Quebec, Manitoba, and the Northwest Territories according to census in 1901. Presented 16th March, 1911.—*Hon. Mr. Power*.. .. ..*Not printed.*

169. Return to an order of the Senate dated 17th February, 1911, for a return showing the correspondence exchanged, the report made by the captain and the log kept by him relating to the trip just made by the steamer *Montcalm* in the lower St. Lawrence, the island of Anticosti and to the Baie des Sept Isles, &c. Presented 16th March, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed*

170. Return to an address of the Senate dated 10th March, 1911, calling for a statement showing:—

1. Who are among the judges of the Superior Court of the province of Quebec, those whose place of residence is fixed by the commission appointing them, and what is, for each of these judges, the place so fixed.

CONTENTS OF VOLUME 24—*Continued.*

2. Who are the judges whose place of residence has been fixed or changed by order in council, and what is for each of these judges, the place of residence now fixed.

3. Who are the judges whose place of residence has never been fixed, neither in the commission nor by any subsequent order in council. and what is the judiciary district to which they were appointed. Presented 21st March, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

171. Return to an order of the House of Commons, dated 30th January, 1911, for a copy of all advertisements, letters, contracts, complaints, reports of inspectors and other correspondence regarding mail routes Trout creek to Loring and Powassan to Nipissing or Restoule. Presented 24th March, 1911.—*Mr. Arthurs*.. .. ..*Not printed*

173. Return to an order of the House of Commons, dated 27th February, 1911, for a return showing what ministers of the Crown were abroad in 1908, 1909 and 1910, on public business and on what business; what expenses were incurred by each while engaged on public business; what persons, if any, accompanied each minister on public business whose expenses were paid by the government, and the amount of such persons expenses. Presented 24th March, 1911.—*Mr. Sharpe (Ontario)*.. .. .. ..*Not printed*

173. Return to a order of the House of Commons, dated 27th February, 1911, for a return showing the value, respectively, of the following products of the country, by provinces, during the years 1909 and 1910, agricultural products of all kinds, including field products of every kind, fruit, vegetables, live stock, &c., dairy products, &c.; timber of all kinds; minerals of all kinds; fish of all kinds; and manufactured goods of all kinds. Presented 24th March, 1911.—*Mr. Macdonell*.. .. ..*Not printed.*

174. Report of the Manitoba Fisheries Commission, 1910-11. Presented 24th March, 1911, by Hon. L. P. Brodeur... .. ..*Not printed.*

175. Return to an order of the House of Commons, dated 14th December, 1910, for a return showing what amount has been paid by the government during the last fiscal year for cab hire and street railway fares in the city of Ottawa for the following persons, with the names and the amounts in each case: ministers of the Crown; speaker of the Senate and House of Commons; civil servants of all grades from deputy ministers down; all other persons employed in any government work or other service. Presented 27th March, 1911.—*Mr. Taylor (Leeds)*.. .. ..*Not printed.*

175*a*. Return to an order of the House of Commons, dated 14th December, 1910, for a return showing what amount has been paid by the government during the last fiscal year for travelling expenses with the names and the expenditure in each case, under the following heads, viz.: railway, steamship, and other lines of transportation; private cars; Pullman cars; tips to waiters; meals and hotel expenses; for the following persons: Ministers of the Crown; civil servants of all grades; immigration agents; and other persons employed by the government on any special or other work. Presented 20th April, 1911.—*Mr. Taylor (Leeds)*.. .. ..*Not printed.*

175*b*. Supplementary return to an order of the House of Commons, dated 14th December, 1910, for a return showing what amount has been paid by the government during the last fiscal year for travelling expenses with the names and the expenditure in each case, under the following heads, viz.: railway, steamship, and other lines of transportation; private cars; Pullman cars; tips to waiters; meals and hotel expenses, for the following persons: Ministers of the Crown; civil servants of all grades; immigration agents; and other persons employed by the government on any special or other york. Presented 20th July, 1911.—*Mr. Taylor (Leeds)*.. .. ..*Not printed.*

CONTENTS OF VOLUME 24—*Continued.*

176. Papers referring to the organization of a Secretariat, as follows:—1. Despatch to the governors of the self-governing colonies relative to the reorganization of the Colonial Office.

2. Note on a visit to Australia, New Zealand and Fiji in 1909, by Sir Charles Lucas, K.C.M.G., C.B., assistant under secretary of state for the Colonies.

3. Report of the Dominions Department of the Colonial Office for the year 1909-1910.

4. Imperial Copyright Conference, 1910, memorandum of the proceedings.

5. Further correspondence relating to the Imperial Conference.

6. Correspondence relating to th Imprial Confrence, 1911. Presented, 28th March, 1911, by Rt. Hon. Sir Wilfrid Laurier.. .. ..*Not printed.*

177. Return to an order of the House of Commons, dated 20th February, 1911, for a copy of the application by or on behalf of the Glace Bay Bait Association, Glace Bay, N.S., for moneys in connection with the cold storage building for the storage of bait, at Glace Bay, N.S.; also a copy of all correspondence between the said association or anyone on its behalf and the government, any department of the government, or anyone on behalf of the government or any of its departments. Presented 28th March, 1911.—*Mr. Maddin*.. .. ..*Not printed.*

177*a*. Return to on order of the House of Commons, dated 3rd April, 1911, for a copy of all the correspondence in connection with the building of bait freezers at Louisburg and Lingan in the riding of South Cape Breton. Presented 20th April, 1911.—*Mr. Mackenzie*.. .. ..*Not printed.*

178. Return to an address of the Senate dated 8th March, 1911, that an order of the Senate do issue for the production of a copy of the complaint made by the commandant of the 61st Regiment against the commandant of the 7th Military District, of the reply of the latter and of all correspondence on the subject between the authorities at Ottawa and those at Quebec and Montreal, together with a copy of the report of the Inspector General respecting the case. Presented 28th March, 1911.—*Hon. Mr. Landry*.. .. ..*Not printed.*

179. Return to an order of the House of Commons, dated 16th March, 1911, for a return showing the average prices of butter and of eggs in London, England, for the past five years in comparison with the prices, respectively, in eastern provinces, in Montreal, in Toronto, in Minneapolis, in Chicago, in Detroit, in Buffalo, in Boston and in New York. Presented 30th March, 1911.—*Mr. Sharpe (Ontario)*.. .. ..*Not printed.*

179*a*. Return to an order of the House of Commons, dated 23rd March, 1911, for a return showing the quantity and value of butter, eggs, poultry, chilled or frozen meat, bacon, lard, apples, vegetables, wheat, barley, cattle, horses and potatoes imported into Canada during the six months ending 1st March, 1911, the countries from which the same were imported and the duty collected thereon. Presented 6th April, 1911.—*Mr. Middlebro*.. .. ..*Not printed.*

179*b*. Supplementary return to an order of the House of Commons, dated 23rd March, 1911, for a return showing the quantity and value of butter, eggs, poultry, chilled or frozen meat, bacon, lard, apples, vegetables, wheat, barley, cattle, horses and potatoes imported into Canada during the six months ending 1st March, 1911, the countries from which the same were imported and the duty collected thereon. Presented 8th May, 1911.—*Mr. Middlebro*.. .. ..*Not printed.*

180. Return to an order of the House of Commons, dated 14th December, 1910, for a return showing the total payments made by the government to the Eclipse Manufacturing

CONTENTS OF VOLUME 23—*Continued.*

Company, Limited, for year 1909-10, and how these contracts were let; the total payments made by the government to the Office Specialty Manufacturing Company, Limited, for year 1909-10, and how these contracts were let; the total payments made by the government to Messrs. Ahearn & Soper for year 1909-10, and how these contracts were let. Presented 3rd April, 1911.—*Mr. Sharpe (Lisgar)*.. .. ..*Not printed.*

181. Return to an order of the Senate dated 22nd February, 1911, for a copy of all orders in council and of all orders issued by the Minister of the Interior giving, from time to time, to the commissioner for the Northwest Territories, since his appointment as such, the instructions which he is to follow in the exercise of his executive in so far as concerns the government of the Northwest Territories. Presented 4th April, 1911. *Hon. Mr. Landry*.. .. ..*Not printed.*

182. Return to an order of the Senate dated 16th March, 1911, calling for a copy of all correspondence relating to the stranding in August, 1910, of the ship *Manchester Engineer* near the Strait of Belle Isle, and of the investigation held with reference thereto at Quebec during the month of September or October last. Presented 4th April, 1911. —*Hon. Mr. Landry*.. .. ..*Not printed.*

183. Return to an order of the House of Commons, dated 15th February, 1911, for a return showing all communications, telegrams, letters, petitions or plans relating to the rifle range at Bear River, N.S., received since January, 1909.

2. From whom received and upon what dates respectively? Presented 5th April, 1911. —*Mr. Jameson*.. .. ..*Not printed.*

184. Return to an order of the House of Commons, dated 14th December, 1910, for a return showing what total amount has been annually expended in each province since 1880 by the Department of Public Works for harbours and rivers, together with the annual totals of said expenditure for the whole of Canada; also that the Department of Public Works prepare and lay upon the Table of this House with this Return a map for each province, showing the location of all wharves, piers, breakwaters, &c., constructed or purchased by the federal government, and presently owned by the Dominion of Canada. Presented 6th April, 1911.—*Mr. Ames*.. .. ..*Not printed.*

185. Return to an order of the Senate dated 22nd February, 1911, for:—

1. Copies of all papers relating to the appointment of Martin Dickie to the command of the 76th Regiment of the counties of Colchester and Hants.

2. Copies of all papers relating to the recommendation of Major J. L. Barnhill by Lieut. General Drury and others to the command of the said regiment.

3. Copies of all documents relating in any way to the reasons or causes why the said Major Barnhill as the senior officer of said regiment should not have been appointed to the command of the same.

4. Copies of all correspondence and other popers and documents relating to the recent reorganization of the 78th Colchester, Hants and Pictou Regiment of "Highlanders." Presented 4th April, 1911.—*Hon. Mr. Lougheed*.. .. ..*Not printed.*

186. Return to an order of the House of Commons, dated 27th March, 1911, for a return showing the mileage of railways owned, controlled or operated in the United States by the Grand Trunk, the Canadian Pacific and other Canadian railway companies.

2. Also the mileage of railways owned, controlled or operated by the United States railway corporations in Canada. Presented 10th April, 1911.—*Mr. Rutan.*

Not printed.

187. Return to an order of the House of Commons, dated 3rd April, 1911, for a copy of all correspondence, declarations, telegrams, mailing lists, and other documents relating

CONTENTS OF VOLUME 24—*Continued.*

to an application asking for the granting of statutory postal privileges to a newspaper published at New Glasgow, Nova Scotia, called the Guysborough *Times*. Presented 10th April, 1911.—*Mr. Sinclair*.. .. ..*Not printed.*

188. Return to an order of the House of Commons, dated 23rd January, 1911, for a copy of all memorials, reports, correspondence and documents in the possession of the government, not already brought down, relating to a survey of a route for a tunnel under the Straits of Northumberland between the province of Prince Edward Island and the mainland of Canada, and also relating to the construction of such tunnel. Presented 12th April, 1911.—*Mr. Richards*.. .. ..*Not printed.*

189. Return to an order of the House of Commons, dated 27th February, 1911, for a copy of all enactments, regulations, documents, papers and information of every kind setting forth or showing the systems or method by which the census is taken in the United Kingdom, the British Dominions and foreign countries, respectively; and showing in what respect, if any, the principle, system or method adopted in the United Kingdom, the British Dominions, and foreign countries differs from that proposed for the approaching census in Canada. Presented 12th April, 1911.—*Mr. Borden*.. .. ..*Not printed.*

189*a*. Forms of schedules, &c., in connection with the census to be taken during the year 1911. Presented 21st April, 1911, by Hon. S. A. Fisher.. .. ..*Not printed.*

189*b*. Supplementary return to an order of the House of Commons, dated 27th February, 1911, for a copy of all enactments, regulations, documents, papers and information of every kind setting forth or showing the systems or method by which the census is taken in the United Kingdom, the British Dominions and foreign countries, respectively; and showing in what respect, if any, the principle, system or method adopted in the United Kingdom, the British Dominions, and foreign countries differs from that proposed for the approaching census in Canada. Presented 10th May, 1911.—*Mr. Borden*.. .. ..*Not printed.*

190. Return to an order of the House of Commons, dated 6th February, 1911, for a return showing:—1. How many employees were connected with the Printing Bureau in 1896?

2. The names of those employees connected with the Printing Bureau who were dismissed between 1896 and 1911, and the date of dismissal and the cause in each case?

3. The names of those employees, who resigned or died between the years 1896 and 1911, and the date of resignation or death in each case.

4. The names of those who have been appointed to positions in connection with the Printing Bureau between 1896 and 1911, and the date of appointment in each case. Presented 12th April, 1911.—*Mr. Edwards*.. .. ..*Not printed.*

191. Return to an address of the Senate dated 17th January, 1911, for the production of a copy of the agreements concluded between the government and the former proprietor of the Stadacona farm at St. Félix du Cap Rouge, with reference to the purchase of the said farm, and of operating the same in the future as an experimental farm, and of all correspondence on these two matters. Presented 19th April, 1911.—*Hon. Mr. Landry* .. .. *Not printed.*

192. Return to an order of the House of Commons, dated 27th March, 1911, for a copy of all the correspondence, contracts, assignments and other documents with regard to what is called the Percy Aylwin irrigation grant, granted to him under order in council dated 1st September, 1908. Presented 8th May, 1911.—*Mr. Campbell*..*Not printed.*

CONTENTS OF VOLUME 24—*Continued.*

193. Return to an order of the House of Commons, dated 27th February, 1911, for a copy of all letters, papers, telegrams, documents, vouchers and pay sheets, showing the names of all persons who supplied materials or worked, and the prices and rates of wages, and sums paid to each, in connection with the construction of a wharf at Deep Brook, N.S. Presented 28th April, 1911.—*Mr. Jameson*.. .. .. ..*Not printed.*

194. Return to an address of the House of Commons, dated 10th April, 1911, for a copy of all papers, documents, memoranda and correspondence relating to the parliament site in the city of Winnipeg for the province of Manitoba, including the reservations made in the Crown grants to the Hudson's Bay Company, and the purpose for which the same were made, and also a copy of the Dominion order in council, dated the 23rd January, 1872, and all subsequent orders in council and correspondence dealing with the site for both provincial and Dominion purposes. Presented 1st May, 1911. —*Mr. Haggart (Winnipeg)*.. .. ..*Not printed.*

194*a*. Supplementary return to an address of the House of Commons, dated 10th April, 1911, for a copy of all papers, documents, memoranda and correspondence relating to the parliament site in the city of Winnipeg for the province of Manitoba, including the reservations made in the Crown grants to the Hudson's Bay Company, and the purpose for which the same were made, and also a copy of the Dominion order in council, dated the 23rd January, 1872, and all subsequent orders in council and correspondence dealing with the site for both provincial and Dominion purposes. Presented 20th July, 1911.—*Mr. Haggart (Winnipeg)*.. .. ..*Not printed.*

195. Return to an address of the House of Commons, dated 23rd January, 1911, for a copy of all orders in council, regulations and rules of the several departments of the government respecting the participation by employees of the government in civic or municipal affairs, and especially with regard to their disability from serving in civic or municipal councils; and all correspondence, documents and papers since the first day of January, 1900, touching the operation of the said orders in council, rules and regulations. Also a list of all employees of the government who have been elected to or have served in city or municipal councils during the said period from the first day of January, 1900, up to the present time, including all those now so serving and those who have been prevented by the government from serving. Presented 1st May, 1911.—*Mr. Borden*.. .. ..*Not printed.*

195*a*. Supplementary return to an address of the House of Commons, dated 23rd January, 1911, for a copy of all orders in council, regulations and rules of the several departments of the government respecting the participation by employees of the government in civic or municipal affairs, and especially with regard to their disability from serving in civic or municipal councils; and all correspondence, documents and papers since the first day of January, 1900, touching the operation of the said orders in council, rules and regulations. Also a list of all employees of the government who have been elected to or have served in city or municipal councils during the said period from the first day of January, 1900, up to the present time, including all those now so serving and those who have been prevented by the government from serving. Presented 3rd May, 1911.—*Mr. Borden*.. .. ..*Not printed.*

196. Return to an address to His Excellency the Governor General of the 3rd April, 1911 for a copy of all orders in council, memoranda, papers and documents, relating to the transfer, or any negotiations concerning the transfer, of a charter known as the Manitoba and South Eastern Railway Company. Presented 2nd May, 1911.—*Mr McCarthy*.. .. ..*Not printed*

CONTENTS OF VOLUME 24—*Continued.*

197. General rule and order of the Exchequer Court of Canada in regard to seals. Presented 2nd May, 1911, by Hon. Charles Murphy.. .. ..*Not printed.*

198. Return to an order of the House of Commons, dated 18th January, 1911, for a return showing how many aliens there are in the service of the government of Canada who are residing out of Canada, their names, nationality, the nature of the service, term of service, residence, and salary.

2. The same information as to aliens now residing in Canada who have been in the service of the government of Canada for a period of three years or more, and the date and length of service.

3. The same information in regard to aliens in the service of the government of any province or provinces of Canada. Presented 9th May, 1911.—*Mr. Lennox.*

Not printed.

199. Return to an order of the House of Commons, dated 1st May, 1911, for a return giving the names of the gentlemen appointed as judges by the present government of Canada since they came into power in 1896, the residences of these gentlemen at the time of appointments, the positions to which they were respectively appointed, and in each case where the appointee had a predecessor in the position, the time which the position was vacant. Presented 11th May, 1911.—*Mr. Lennox*.. .. ..*Not printed.*

200. Return to an order of the House of Commons, dated 16th January, 1911, for a copy of all correspondence, telegrams, reports, contracts, papers and memorials in the possession of the government relating to the establishment of a fast Atlantic service between Canada and any other country; also with reference to an all red route, cable, or telegraph service, betyeen Canada and any other country, within the past fifteen years. Presented 16th May, 1911.—*Mr. Armstrong*.. .. ..*Not printed*

201. Return to an order of the House of Commons, dated 18th May, 1911, for copies of any correspondence between the government of New Brunswick, or any member or members thereof, and the government of Canada, or any member thereof, with reference to changing the Subsidy Act, 1910, with respect to a subsidy for a line of railway from Grand Falls in the province of New Brunswick to the city of St. John in the same province. Presented 19th May, 1911.—*Mr. Carvell*.. .. ..*Not printed.*

202. Copy of report of Board of Conciliation and Investigation in the matter of the Western Coal Operators' Association and its employees. Presented 19th July, 1911, by Hon. W. L. Mackenzie King.. .. ..*Not printed.*

203. Return to an order of the House of Commons, dated 23rd January, 1911, for a return—

1. Showing in tons the east-bound and the west-bound traffic on the Intercolonial railway for the five years ending 30th June, 1910.

2. The miles of main trunk line and branches of the Intercolonial railway in each province through which it passes, distinguishing the trunk line from the branches.

3. Showing in tons the west-bound traffic originating in each of the maritime provinces during the period of five years ending 30th June, 1910. Presented 18th July, 1911.—*Mr. Sinclair*.. .. ..*Not printed.*

204. Return to an order of the House of Commons, dated 13th March, 1911, for a copy of all correspondence, telegrams, &c., during the past twelve months between Mr. E. J. Walsh, C.E., and the Minister of Department of Railways and Canals in regard to the Newmarket Canal. Presented 18th July, 1911.—*Mr. Wallace* .. .. ..*Not printed*

CONTENTS OF VOLUME 24—*Concluded.*

205. Return to an order of the House of Commons, dated 20th April, 1911, for a return showing:—1. The quantity of bituminous coal imported into Ontario transhipped into other provinces in 1910.

2. The quantity of bituminous coal imported into Ontario in 1910 imported by the different railway companies.

3. The quantity and value of slack coal imported into Ontario in 1910, what portion of this slack coal was transhipped to other provinces, and what imported by railway companies. Presented 18th July. 1911.—*Mr. Macdonell*.. .. .. ..*Not printed.*

206. Return to an order of the House of Commosn, dated 24th April, 1911, for a return showing in detail the expenses incurred and paid for the Paris exposition in 1900, as payments of the Colonial committee on account of space, &c., $87,000, as shown in the report of the Auditor General for 1899-1900, page D—15. Presented 21st July, 1911.—*Mr. Paquet*.. .. ..*Not printed*

207. Report of Mr. Justice Murphy, Royal Commissioner appointed to investigate alleged Chinese frauds and opium smuggling on the Pacific coast. 1910-11, together with copies of the evidence taken and exhibits produced before the said commissioner. Presented 21st July, 1911, by Rt. Hon. Sir Wilfrid Laurier.. .. ..*Not printed.*

208. Minutes of Proceedings of the Imperial Conference, 1911. Presented 27th July, 1911, by Rt. Hon. Sir Wilfrid Laurier.

Printed for both distribution and sessional papers.

208*a*. Despatches, &c., relative to the simultaneous publication of memorandum of conference on the subject of the status of Dominion navies. Presented 27th July, 1911, by Rt. Hon. Sir Wilfrid Laurier.

Printed for both distribution and sessional papers.

208*b* and **208***c*. Memorandum of conferences between the British admiralty and representatives of the Dominions of Canada and Australia; and also. copy of a cable despatch from Mr. Harcourt to Lord Grey. Presented 28th July, 1911, by Rt. Hon. Sir Wilfrid Laurier.. .. ..*Printed for both distribution and sessional papers*

208*d*. Report of a Committee of the Imperial Conference convened to discuss defence (military), of the War Office, 14th June and 17th June, 1911. Presented 28th July, 1911 by Hon. S. A. Fisher.. .. ..*Printed for both distribution and sessional papers.*

209. Memorandum respecting the printing of voters' lists. Presented 27th July. 1911, by Rt. Hon. Sir Wilfrid Laurier.. .. ..*Not printed.*

210. Text of Pelagic Sealing Treaty signed at Washington, 7th July, 1911. Presented 27th July, 1911, by Rt. Hon. Sir Wilfrid Laurier.. .. .. ..Printed for sessional papers.

211. Interim report, Alberta and Saskatchewan Fisheries Commission, 1910. Presented 28th July, 1911, by Hon. L. P. Brodeur.. .. ..*Not printed.*

REPORT OF THE PROCEEDINGS FOR THE PRECEDING YEAR OF THE COMMISSIONERS OF INTERNAL ECONOMY OF THE HOUSE OF COMMONS, PURSUANT TO RULE 9.

THE SPEAKER'S CHAMBERS,
HOUSE OF COMMONS,
17th December, 1909.

A Meeting of the Board of Commissioners of Internal Economy was held in the Speaker's Chambers on Friday, the 17th day of December, 1909, at 11.30 a. m.

Present: The Hon. The Speaker.
The Hon. W. S. Fielding,
The Hon. L. P. Brodeur,
The Hon. William Pugsley, and
The Hon. William Paterson.

The following Resolutions were adopted:

1. Resolved—That the claim of Mr. J. B. R. Laplante, Clerk Assistant, for the payment to him of $150 increase of his salary, known as the "flat increase," of the Session of 1909, which he alleges to be improperly withheld, be referred to the Department of Justice for its opinion, and that the Secretary be requested to forward to the Department of Justice all the correspondence and papers in connection with the said claim.

2. Resolved—That inasmuch as the retiring Chief Translator, Mr. Frechette, contemplates visiting Europe during the continuance of his leave of absence, he be requested to make a report upon the systems of translation of Debates and public documents employed in Belgium and Switzerland, respectively, if he can conveniently do so, together with any suggestions in connection therewith that he may deem useful for the House of Commons of Canada. Should Mr. Frechette undertake an enquiry and report on this subject the Board will recommend and approve of an extension of his leave of absence for three months longer for that purpose.

3. Resolved—That the Board deems it desirable that at the close of this Session the residential apartments in the House now occupied by the Sergeant-at-Arms be vacated by him and transferred for the use of the House of Commons, the Sergeant-at-Arms to retain office room in the building . In consideration of the giving up of the said residential apartments an annual compensation therefor shall be made to that official by way of addition to his cash salary so that in any event his salary shall be at all times equal to that of the Clerk Assistant of the House.

4. Resolved—That the Sergeant-at-Arms be requested to report to the Board, at the earliest possible date, as to any other apartment in the House

of Commons portion of the Parliament Buildings which are used for residential purposes, their number, capacity and value; as to whether the same are necessary for the purposes of the House, particularly as to the rooms occupied by the Superintendent of the Messenger Service and Housekeeper (Mr. Dube).

5. Resolved—That the application of Mr. A. H. O'Brien, Law Clerk, for the reconsideration of the question of his salary, be not entertained.

6. Resolved—That after the close of the present Session the custom of providing a trunk and separate package of stationery for Members of the House, and others, be discontinued.

7. Resolved—That the Secretary be directed to subscribe for the Canadian Railway Guide and Gazetteer, for one year; copies to be supplied to Members of the House.

8. Resolved—That the correspondence in relation to the superannuation of the Members of the Hansard staff, be referred to the Treasury Board for its consideration.

9. Resolved—That the question of recommending the appointment of an additional Official Stenographer, presented before the Board by Messrs. Matthews and Dickson, be laid over for further consideration.

10. Resolved—That the application of the Hansard Amanuenses for an increase of daily compensation be declined.

11. Resolved—That the application of Theo. Joncas, Sessional Messenger, for payment of his salary during the Session of 1908-1909, on the ground that during that Session he was disabled by sickness from being present to attend to his duties, and being absent in consequence of sick leave be granted.

12. Resolved—That the leave of absence granted to Mr. Patrick Minnehan, Sessional Messenger, on account of sickness, during the present session, be approved.

CHARLES MARCIL,
Speaker.

SPEAKER'S CHAMBERS

Tuesday, Feb. 1st, 1910.

Meeting of the Board of Internal Economy of the House of Commons, was held in the Speaker's Chambers on Tuesday, February 1st, 1910, at 9 o'clock p. m.

Present: The Hon. The Speaker,
The Hon. W. S. Fielding, and
The Hon. William Pugsley.

The Secretary reported that he had laid the question of Mr. Laplante's claim to the "flat increase" of salary, referred to in the Minutes of the Board of the 17th December last, including all the papers in the case, before the Department of Justice.

The following letter from the Deputy Minister of Justice was read:

"Ottawa, 7th January, 1910.

"Sir,—

"I have considered the questions submitted by your letter of the 29th "ult. as to the legality of Mr. Laplante, Clerk Assistant of the House of "Commons, for a flat increase of $150.00, provided by the Flat Increase "Act of 1909, and upon the facts as stated and as appearing by the corre- "spondence which you submit, I have no doubt that Mr. Laplante is "eligible to be granted the said increase. The objection stated by the "Auditor General is, I think, untenable, since Section 2 of the said Act "does not appear to have any application to Mr. Laplante's case, inasmuch "as the increase of $700.00 which he has already received was not affected "upon or by reason of an organization and classification under the Civil "Service Amendment Act, 1908, but got independently under a grant au- "thorized by special appropriation.

"I have the honour to be, Sir,

"Your obedient servant,

"E. L. NEWCOMBE,

"Deputy Minister of Justice."

The Board decided to take no action in the matter.

CHARLES MARCIL,
Speaker.

HOUSE OF COMMONS.

SPEAKER'S CHAMBERS.

Meeting of the Board of Internal Economy, Thursday, March 3rd, 1910.

Present: The Hon. The Speaker,
The Hon. W. S. Fielding, and
The Hon. William Pugsley.

Upon reading the report of the Clerk of the House in regard to the late Murdock McKinnon, Chief of the English Sessional Clerks, who died on the 3rd day of March, 1909, and who had been for thirty years in the Public Service, of which the last sixteen years were in the service of the House of Commons, the family of the deceased were voted the usual two months' gratuity.

Whereas the practice of permitting Rooms in the House of Commons portion of the Parliamentary Buildings for other than Parliamentary or Governmental purposes has proved unsatisfactory and frequently embarrassing, and owing to the fact that applications from Societies and other individuals are constantly being made for the use of these Rooms for various meetings and objects for which leave cannot well be refused without an appearance of partiality or favouritism, It is Resolved that for the future the use of any of these Rooms for other than purely Parliamentary and Governmental purposes be prohibited.

CHARLES MARCIL,
Speaker.

HOUSE OF COMMONS,
THE CLERK'S OFFICE,

Tuesday, March 22nd, 1910.

Meeting of the Board of Internal Economy.

Present: The Hon. The Speaker,
The Hon. W. S. Fielding,
The Hon. William Pugsley.

On reading the correspondence between the Speaker of the House, The Clerk and Col. Smith, Sergeant-at-Arms, on the subject of the rent charged on account of residence, and the valuation of the same as made by the Chief Architect, it was resolved that the rent charge of $800 made against the Sergeant-at-Arms on account of his residence be reduced to $500 per annum and that the difference of three hundred dollars be added to the cash portion of his salary and that the said sum be provided for in the Supplementary Estimates.

On reading the application of Mr. James O'Farrell, Sessional Clerk, who resides in Montreal, for pecuniary consideration on account of illness, and of his being unable to attend during the present Session of Parliament, also the certificate of Dr. Thomas Lovett, of Montreal, and the letter of R. Bickerdike, M. P., and it appearing that Mr. O'Farrell had been in the service of the House for some thirty-three years and was unable to attend owing to having broken his leg in October last and the illness consequent thereon, it was resolved that Mr. O'Farrell be allowed leave of absence for the present Session and that he be allowed the sum of $2.50 per diem in lieu of full payment during the Session.

The Board then adjourned.

CHARLES MARCIL,
Speaker.

HOUSE OF COMMONS,
SPEAKER'S CHAMBERS,

Wednesday, 4th May, 1910.

Minutes of proceedings of Internal Economy Commissioners, held on Wednesday, the 4th day of May, 1910.

Present: The Hon. The Speaker,
The Hon. W. S. Fielding,
The Hon. William Pugsley.

The following Resolutions were adopted:

1. Resolved—That the number of Post Office Sessional Clerks be increased from ten (as fixed by the resolution of January 28th, 1908), to eleven and that Mr. Alexander Sharp be transferred from the Messenger Service to the Post Office Branch.

2. Resolved—That the pay of the Post Office Sessional Clerks be increased from $4 to $5 per diem, the said increase to take effect from the beginning of the present Session of Parliament.

3. Resolved—That the services of J. Moreau be retained as labourer during the Recess of Parliament at $1.75 per diem and that the Accountant be authorized to pay him such wage dating from this date.

4. Resolved—That the pay of the Debates Amanuenses of the House of Commons be increased from $4 to $5 per diem, the same to take effect from the beginning of the present Session of Parliament.

5. Resolved—That the Clerk of the House be requested to communicate with the Public Works Department requesting it to furnish one of the Dominion Police for daily attendance in the outer lobby of the House during the Recess of Parliament.

6. Resolved—That the Sergeant-at-Arms be desired to authorize Members of the Press Gallery to occupy the Press Room in the Parliament Building during the Recess of Parliament.

7. Resolved—That the Board having heard read several communications from the Sessional Clerks of the House asking for some change in their status and remuneration, that the Clerk of the House be desired to make a report to this Board at an early date upon the subject of the status, pay and employment of the Sessional Clerks and to recommend any improvements in their status and work which may be of advantage to the service of the House.

8. Resolved—That the Clerk having represented that it would be in the interests of economy and the efficiency of the service of the House that an additional permanent official stenographer to committees of the House be appointed, if possible, before the opening of next session of Parliament, that the Speaker and Clerk be authorized to take the necessary steps to have such appointment made under the provisions of the Civil Service Act, the said appointment to be made to the 2nd Division Subdiv. A.

9. Resolved—That the Clerk of the House be requested to communicate with the Public Works Department expressing the desire of this Board that the Press Gallery of the House of Commons be extended in such a manner as to afford accommodation for a larger number of Members of the Press Gallery, the same to be undertaken and completed before the opening of the next session of Parliament.

HOUSE OF COMMONS,
SPEAKER'S CHAMBERS,

Wednesday, 16th November, 1910.

Minutes of Proceedings of Board of Commissioners of Internal Economy, held on Wednesday, the 16th day of November, 1910.

Present: The Hon. The Speaker,
The Hon. William Paterson,
The Hon. L. P. Brodeur,
The Hon. William Pugsley.

The Clerk of the House having informed the Board that the superannuation of Mr. A. Frechette, Law Translator and Chief of the Translation Branch, takes effect from 1st November last and that His Honour the Speaker, upon his recommendation, had promoted Mr. L. Laframboise to the

vacancy, it was Resolved that the said promotion of Mr. Laframboise be concurred in.

The Clerk of the House also recommended that Mr. Laframboise be promoted to grade 1st Division Sub-Division A in place of Mr. Frechette, superannuated, and the Speaker having concurred in this recommendation the same was approved by the Board.

Mr. Emery Perrin, Translator, having applied to His Honour the Speaker for leave of absence for six months from 1st November with a view to superannuation and it appearing that Mr. Perrin is about the age of sixty-seven years and has been in the service of the House over thirty-two years and that his service during that period having been thoroughly satisfactory to the Authorities of the House, his application was approved and leave granted accordingly.

Mr. Remi Tremblay, Translator, who has been in the service of the House for twenty-eight years, having been recommended for promotion from grade 2nd Division Sub-Division A, to grade 1st Division Sub-Division B, in place of Mr. Laframboise promoted from the latter grade, and His Honour the Speaker having concurred in such recommendation, Resolved that the Board also approve of the same.

The Board during the last Session of Parliament having authorized the Speaker and Clerk to take the necessary steps to have an additional Permanent Stenographer to Committees of the House appointed before the next Session of Parliament, and provision for the payment of such official having been placed in the Estimates of the current year, it was decided that Mr. Charles S. Blue, a competent Stenographer, be recommended for appointment to the said position, under the provisions of the Civil Service Act, his said appointment to be made to the Second Division Sub-Division A.

Upon reading a request signed by upwards of one hundred Members of the House of Commons and several letters from Members of the House, and a report from the Clerk of the House, upon the subject of the employment of Sessional Stenographers and Typists for the assistance of Members during the Sessions of Parliament, the following Resolutions were adopted:

Resolved—That it is advisable that the assistance desired by the Members be furnished to the extent of one Stenographer and Typist to each ten Members of the House (not including Members of the Government having seats in the House, nor those other Members of the House already, under the practice of the House, supplied with clerical assistance). Upon this basis it is estimated twenty such Stenographers will supply the requirements.

Further Resolved—That it is to be understood that only men Stenographers are to be employed and all such Stenographers upon appointment to be subject to all the rules as to discipline applicable to other employees of the House.

The following Rules are to be observed in regard to the appointment and services of such Sessional Stenographers:

(a) Each such Stenographer and Typist is to be appointed by His Honour the Speaker (upon being satisfied that the nominee has the necessary qualification) upon the nomination, in writing of ten Members, none of whom may sign other nomination applications.

(b) The nomination application shall be filed with the Clerk of the House for submission to the Speaker and the Clerk shall cause to be kept a register of the names of the applicants for each such Stenographer and of the Stenographer so appointed.

(c) The appointment is to be deemed to be for the Session only at which the same is made but nominees may be re-appointed at ensuing Sessions upon the like applications as when first appointed.

Resolved—That the Government be requested to recommend, upon estimate being given, the appropriation of a sufficient amount each Session to pay such Stenographers, such pay to be the same as that allowed the Sessional Clerks already on the Staff of the House.

CHARLES MARCIL,
Speaker.

RETURN

[47]

IN PURSUANCE OF SECTION 16 OF THE GOVERNMENT ANNUITIES ACT, 1908, containing a statement of the business done during the fiscal year ending March 31st, 1910.

Assets

Fund as at March 31st, 1909	$ 50,320.30	
Receipts (less Payments) as per balance	434,605.10	
Fund as at March 31st, 1910		$484,925.40

Liabilities

Net present value of all outstanding contracts as computed by the Actuary, on the British Offices Annuity Experience with 4% compound interest	$484,925.40

Receipts

Purchase money received for Immediate Annuities	$245,736.03	
Purchase money received for Deferred Annuities	190,206.01	
Extra, including interest set aside by Government to maintain reserve	12,640.00	
		$448,582.04

Payments

Immediate Annuities paid	$ 12,525.79	
Refunded on Immediate Annuities (amounts in excess of purchase money required)	93.71	
Refunded or Deferred Annuities where contract had not issued and applicant for any reason wished to withdraw	1,357.44	
		13,976.94
Balance, March 31st, 1910		434,605.10
		$448,582.04

EXHIBIT OF CONTRACTS

PLAN	Number and Amount of Contracts entered into from April 1/09 to March 31/10.		Total Number and Amount of Contracts in force on March 31/10	
	Number	Amount	Number	Amount
(1) On lives of males—				
Immediate	41	$10,682.31	45	$11,972.31
Immediate, guaranteed (3)	10	2,375.00	12	2,550.00
Deferred Plan A (1)	224	51,258.35	264	60,258.80
Deferred Plan B (2)	42	13,425.22	51	15,359.68
Deferred, Guaranteed (3)	5	1,644.36	5	1,644.36
(2) On lives of females—				
Immediate	37	9,338.24	41	10,548.70
Immediate, Guaranteed (3)	9	1,777.82	10	2,081.06
Deferred Plan A (1)	149	27,208.08	161	29,324.07
Deferred Plan B (2)	42	12,009.43	44	12,759.43
Deferred, Guaranteed (3)	3	1,800.00	3	1,800.00
(3) Last Survivor—				
Immediate	7	1,650.31	8	1,950.31
Deferred	2	976.60	2	976.60
TOTAL	571	$134,145.72	6646	$151,225.32

(1). Under Plan "A," in event of death before first payment of Annuity falls due, the total amount paid in, with three per cent. compound interest, will be refunded to the legal representatives.

(2). Under Plan "B," the same Annuity is obtainable for smaller payments, but there will be no return in the event of death before Annuity becomes due.

(3). Annuity to be paid for certain number of years should death occur previously, but after the guaranteed term so long as the annuitant lives.

SUMMARY

Total number of contracts in force on March 31st, 1910 (Males 377, Females 259, Last Survivor 10) 646

Total amount of Annuities $151,225.32

S. T. BASTEDO,

Superintendent.

November 30th, 1910.

(NOTE:—Up to and inclusive of November 30th, 1910, 1136 annuities have been purchased, representing $266,960.00 in Annuities, and on account of which $737,612.54 has been received in purchase money.)

RETURN

[48]

To an Order of The House of Commons, dated 1st December, 1910, for a copy of the existing Lobster Fishery Regulations, adopted by Order in Council of the 30th September, 1910.

By Order,

CHAS. MURPHY,

Secretary of State.

ORDER IN COUNCIL

[1854]

AT THE GOVERNMENT HOUSE AT OTTAWA.

Friday, the 30th day of September, 1910.

PRESENT:

HIS EXCELLENCY THE GOVERNOR GENERAL IN COUNCIL.

His Excellency in Council, in virtue of the provisions of section 54 of The Fisheries Act, chapter 45 of the Revised Statutes, is pleased to order and it is hereby ordered as follows:—

Section 5 as well as the subsections thereof of the General Fishery Regulations, established by Order in Council, dated 12th September, 1907, which section provides the Lobster Fishery Regulations, is rescinded and the following substituted in lieu thereof:—

SECTION 5.—LOBSTER FISHERY

(See also Fisheries Act, Sections 35 to 42, inclusive, and 76 to 82 inclusive.)

1. No one shall fish for, catch, kill, buy, sell, or have in possession lobsters, from the 30th day of June in each year, to the 5th day of January following both days inclusive, on and along that portion of the coast or the waters thereof, of the Province of New Brunswick, embraced and included within the Counties of Charlotte and St. John; nor shall anyone within the above described limits, fish for, catch, kill, buy, sell or have in possession, at any time any lobster or lobsters, the carapace of which measures less than 4¾ inches in length.

2. No one shall fish for, catch, kill, buy, sell or have in possession lobsters from the 30th day of June in each year, to the 14th day of January following, both days inclusive, on and along that portion of the coast, or waters thereof, of the Provinces of New Brunswick and Nova Scotia, embraced and included within the County of Albert, New Brunswick, and the Counties of Kings and Annapolis, Nova Scotia.

3. No one shall fish for, catch, kill, buy, sell or have in possession lobsters, from the 16th day of June in each year, to the 5th day of January following, at nine o'clock, a.m., both days inclusive, on and along that portion of the coast or the waters thereof, of the Province of Nova Soctia, embraced and included within the County of Digby.

4. No one shall fish for, catch, kill, buy, sell or have in possession, lobsters, from the 31st day of May to the 14th day of December, in each year, both days inclusive, on and along that portion of the coast or the waters thereof, of the Province of Nova Scotia, embraced and included within the Counties of Yarmouth, Shelburne, Queens, Lunenburg, and that portion of the County of Halifax west of a line running S.S.E. from St. George's Island, Halifax Harbour, and coinciding with the fairway buoys, in the entrance of the said harbour.

5. No one shall fish for, catch, kill, buy, sell or have in possession lobsters, from the 1st day of July in each year, to the 31st day of March following, both days inclusive, on and along that portion of the coast of the Province of Nova Scotia or the waters thereof, from the aforesaid line, running S.S.E. from St. George's Island, Halifax Harbour, and coinciding with the fairway buoys, in the entrance of the said harbour, extending eastwardly, and following the coast line, as far as Red Point, between Martin Point and Point Michaux, in the Island of Cape Breton, and including Chedabucto Bay and St. Peter's Bay, and the coasts and waters of all the islands lying in and adjacent to these Bays, and including the coasts and waters of the Gut of Canso, as far as a line passing from Flat Point, in Inverness County, to the Lighthouse in Antigonish County opposite.

6. No one shall fish for, catch, kill, buy, sell or have in possession lobsters, from the 1st day of August in each year, to the 30th day of April following, both days inclusive, on and along that portion of the coast of Cape Breton Island, in the Province of Nova Scotia, or the waters thereof, from Red Point, between Martin Point and Point Michaux, in the Island of Cape Breton, and extending to and around Cape North, as far as and including Cape St. Lawrence; also, on the north shore of the Gulf St. Lawrence, from and including the Bay of Blanc Sablon, in the Province of Quebec, westward to the head of tide, embracing the coasts and waters of all the islands adjacent to the said shore, and including the Island of Anticosti.

7. No one shall fish for, catch, kill,, buy, sell or have in possession lobsters, from the 11th day of July to the 31st day of August following, both days inclusive, and from the 1st day of October, in each year, to the 19th day of April following, both days inclusive, on and along the coast or the waters thereof of the Magdalen Islands, including Bird Rocks and Byron Island: but no one shall, at any time, fish for lobsters in the lagoons of these islands.

8. No one shall fish for, catch, kill, buy, sell or have in possession lobsters, from the 11th day of August in each year, to the 24th day of May following, both days inclusive, along the coasts and in the waters of that portion of Northumberland Strait, between a line, on the north-west, drawn from Chockfish River, in New Brunswick, to West Point, in Prince Edward Island, and a line on the south-east, drawn from Indian Point, near Cape Tormentine, in New Brunswick, to Cape Traverse, in Prince Edward Island.

9. No one shall fish for, catch, kill, buy, sell or have in possession lobsters, from the 11th day of July in each year, to the 25th day of April following,

both days inclusive, on and along that portion of the coast of the Province of Prince Edward Island or the waters thereof, not embraced in the immediately foregoing subsection, viz: from West Point, around the west, north, east and that portion of the south coast of the Province to Cape Traverse.

10. No one shall fish for, catch, kill, buy, sell or have in possession lobsters, from the 11th day of July in each year, to the 19th day of April following, both days inclusive, on and along any portion of the coasts of Canada or the waters thereof, where lobsters are caught, not embraced in the limits described in the foregoing subsections, viz: from, but not including, Cape St. Lawrence, in the Island of Cape Breton, southwestwardly to Flat Point, Inverness County, in the Island of Cape Breton, and from the Lighthouse in Antagonish County, Nova Scotia, opposite Flat Point, Inverness County, westwardly, embracing the coast and waters thereof of the portion of the County of Antigonish west of the Lighthouse specified, and of the Counties of Pictou, Colchester and Cumberland, Nova Scotia, and that portion of the coast of waters thereof of Westmoreland County to Indian Point, near Cape Tormentine; then northwardly from Chockfish River, Kent County, New Brunswick, embracing the coast and waters thereof of the County of Kent, from the River specified, and of the Counties of Northumberland, Gloucester and Restigouche, New Brunswick, as well as the coast and waters thereof of the Counties in Quebec, south of the River St. Lawrence, to the head of tide.

11. No one shall fish for, catch, kill, buy, sell or have in possession for any purpose whatever, any berried lobster or lobsters, or any soft shell lobster or lobsters. Such lobsters when caught shall be liberated alive, by the person catching it or them.

12. No one shall set or place lobster traps or other fishing apparatus for the purpose of taking lobsters, in any water of the depth of two fathoms or under.

13. No one shall set or place lobster traps or other fishing apparatus for the purpose of taking lobsters, at a distance of less than 100 yards from any stationary salmon net, set for the purpose of taking salmon.

14. No one shall, for canning purposes, offer for sale, sell, barter, supply or purchase any fragments of lobsters, lobsters purposely mutilated or broken up, or any broken lobster meat, and all fragments of lobsters, lobsters purposely mutilated or broken up, or broken lobster meat, so offered for sale, sold, bartered, supplied or purchased, shall be liable to seizure and confiscation, unless possessed for the purpose of domestic consumption only, and not for canning, the proof whereof shall devolve on the owner or possessor; nor for canning purposes, shall any lobster or lobsters, be boiled, or partially prepared elsewhere than in the cannery licensed for that purpose.

15. No one shall, for canning purposes, boil lobsters on board any ship, vessel, boat or floating structure of any description whatever, except under special license from the Minister of Marine and Fisheries.

16. No one shall prepare to fish for lobsters, by placing or setting any buoys, lines or other gear used in connection with lobster fishing, before six o'clock in the morning of the day on which it is lawful to take lobsters in the locality affected, except as provided in subsection 3 hereof.

17. All lobster traps constructed after the 31st day of December, 1910, shall have the laths on all portions thereof, not less than 1¼ inches apart,

and this space must remain clear and nothing shall be done to diminish it, and any netting that may be used in such traps, shall have meshes of not less than 3 inches extension measurement, and nothing shall be done to practically diminish the size of the mesh; and all lobster traps used after the 31st December, 1910, but which were constructed before that date, and which do not comply with the above requirements, shall be so remodelled, that each of the three lower spaces between the laths next to the bottom of the trap, on either side, shall be not less than 1¼ inches wide.

18. The use of trawls for the purpose of catching lobster is prohibited in the waters of the Counties of Gaspé and Bonaventure in the Province of Quebec.

RODOLPHE BODREAU,

Clerk of the Privy Council.

COMMISSION ON CONSERVATION.

Canada.

HONOURABLE CLIFFORD SIFTON, CHAIRMAN.
JAMES WHITE, SECRETARY.

REPORT

OF THE

FIRST ANNUAL MEETING

HELD AT OTTAWA, JANUARY 18TH TO 21ST, 1910.

PRINTED BY ORDER OF PARLIAMENT.

OTTAWA
PRINTED BY C. H. PARMELEE, PRINTER TO THE KING'S MOST
EXCELLENT MAJESTY.
1911.

[No. 52—1911]

To His Excellency the Right Honourable Sir Albert Henry George, Earl Grey, G.C.M.G., &c., &c., Governor General of Canada.

MAY IT PLEASE YOUR EXCELLENCY:

The undersigned has the honour to lay before your Excellency the Report of the First Annual Meeting of the Commission of Conservation for the fiscal year ending March 31, 1910.

Respectfully submitted,

CLIFFORD SIFTON,
Chairman.

OTTAWA, April 18, 1910.

SIR,—

I have the honour to transmit herewith the Report of the First Annual meeting of the Commission of Conservation which was held at Ottawa, January 18th to 21st, 1910. Included therein are the reports of the meeting, the addresses of the Chairman and of the specialists who addressed the Commissioners, also copies of the Act establishing the Commission, the names of the members of the Commission and of the various committees of the Commission.

I have the honour to be,

Sir,

Your obedient servant,

JAMES WHITE,

Secretary.

HON. CLIFFORD SIFTON, Chairman,
Commission of Conservation.

SIR,—

I have the honour to transmit herewith the Report of the First Annual meeting of the Commission of Conservation which was held at Ottawa, January 18th to 21st, 1910. Included therein are the reports of the meeting, the addresses of the Chairman and of the specialists who addressed the Commissioners, also copies of the Act establishing the Commission, the names of the members of the Commission and of the various committees of the Commission.

I have the honour to be,

Sir,

Your obedient servant,

JAMES WHITE,

Secretary.

HON. CLIFFORD SIFTON, Chairman,
Commission of Conservation.

TABLE OF CONTENTS

	PAGE
Act Establishing the Commission of Conservation	1
Amending Act respecting the Commission of Conservation	3
Order in Council appointing Commissioners	5
Committees of the Commission	7
Inaugural Address *Hon. Clifford Sifton.*	9
Address by His Excellency, Earl Grey	27
Scientific Forestry in Europe: its Value and Applicability in Canada *Dr. B. E. Fernow*	28
The Conservation of Agricultural Resources *Dr. James W. Robertson*	37
Possible Economies in Production of Minerals of Canada *Dr. Eugene Haanel.*	49
The Conservation of the Natural Resources of Ontario *Hon. Frank Cochrane.*	59
The Conservation of the Water-powers of Ontario *Hon. Adam Beck.*	65
Fish and Game in Ontario *Kelly Evans.*	77
Fur-bearing Animals in Canada, and How to Prevent their Extinction *F. T. Congdon, M.P.*	81
Measures for the Maintenance and Improvement of the Public Health *P. H. Bryce, M.D.*	86
Diseases of Forest Trees *H. T. Gussow.*	100
Insects Destructive to Canadian Forests *Dr. C. Gordon Hewitt.*	105
The Water Wealth of Canada, with Special Reference to the Ottawa River *Charles R. Coutlee. C.E.*	112
Discussion on Organization	124
Committees	127
Reports of Committees:—	
(*a*) Forests	128
(*b*) Fisheries, Game and Fur-bearing Animals	136
(*c*) Minerals	137
(*d*) Waters and Water-powers	138
(*e*) Lands	139
(*f*) Press and Co-operating Organizations	140
(*g*) Public Health	142
General Discussion	143

ACT ESTABLISHING THE COMMISSION OF CONSERVATION

8-9 EDWARD VII

CHAP. 27

AN ACT TO ESTABLISH A COMMISSION FOR THE CONSERVATION OF NATURAL RESOURCES

[*Assented to 19th May,* 1909]

His Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:—

1. There shall be a body to be known as "The Commission of Conservation," hereinafter called "the Commission."

2. In addition to ex-officio members, the Commission shall consist of twenty members appointed by the Governor in Council, and who shall hold office during pleasure.

3. The Minister of Agriculture, the Minister of the Interior, the Minister of Mines and the member of each provincial government in Canada who is charged with the administration of the natural resources of such province shall be ex-officio members of the Commission.

4. Of the members appointed by the Governor in Council, at least one member appointed from each province shall be a member of the faculty of a university within such province, if there be such university.

5. The Governor in Council may appoint one of the members of the Commission to be its chairman.

6. The chairman shall preside at all meetings of the Commission, take the necessary steps for carrying into effect the decisions and recommendations of the Commission, direct the work of the permanent officers thereof, and generally act as the administrative head of the Commission.

7. The Commission shall meet annually on the third Tuesday in January, in the city of Ottawa, or in such other place in Canada as is decided by the Commission or by any committee thereof appointed to decide upon the place of meeting.

8. The chairman may, with the concurrence of five members of the Board, summon a special meeting of the Commission at any time or place.

9. No fees or emoluments of any kind whatever shall be received by the chairman or other members of the Commission, but they shall be repaid their actual reasonable disbursements incurred in travelling to, returning from, and remaining at meetings of the Commission. The chairman shall be paid any similar disbursements incurred in travelling or otherwise attending to the work of the Commission. Before any such payment is made a statement shall be rendered by the member of the Commission to whom payment is to be made, which statement shall be certified by the secretary and countersigned by the chairman, and thereafter payment may be made out of any moneys appropriated by Parliament for the purpose of the Commission.

10. It shall be the duty of the Commission to take into consideration all questions which may be brought to its notice relating to the conservation and better utilization of the natural resources of Canada, to make such inventories,

collect and disseminate such information, conduct such investigations inside and outside of Canada, and frame such recommendations as seem conducive to the accomplishment of that end.

11. The Governor in Council may appoint a secretary to the Commission and such officers and clerks under him as are deemed necessary for carrying on the work of the Commission. Such officers and clerks shall be appointed under *The Civil Service Amendment Act*, 1908.

12. The Commission may, notwithstanding the provisions of *The Civil Service Act*, employ such assistants as are necessary for the purpose of any special work or investigation, and the remuneration and expenses of such assistants in carrying on the work committed to them may be paid out of the said Parliamentary appropriation on the certificate of the chairman and the secretary; but no permanent officer or employee shall be appointed by the Commission, and the employment of such assistants shall terminate immediately upon the completion of the special work for which they were employed.

13. The Commission shall make its report to the Governor in Council at the end of each fiscal year, and the said report shall be printed, and laid before both Houses of Parliament.

SESSIONAL PAPER No. 52

An Act Respecting the Commission for the Conservation of Natural Resources.

(*Passed the House of Commons, April* 8, 1910.)

His Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:—

1. Chapter 27 of the Statutes of 1909, intituled "An Act to establish a Commission for the Conservation of Natural Resources," may be cited as *The Conservation Act.*

2. Section 7 of the said Act is repealed and the following is substituted therefor:—

"7. The Commission shall meet annually in the city of Ottawa, or in such other place in Canada as is decided by the Commission or by any committee thereof appointed to decide upon the place of meeting.

"2. The annual meeting shall be held on the third Tuesday in January, unless the Commission, by resolution, shall fix another date."

3. Section 8 of the said Act is amended by adding thereto the following subsection:—

"2. The chairman and the chairman of a committee may summon a meeting of such committee at any time or place."

4. Section 9 of the said Act is amended by adding after the word "Commission" in the seventh line thereof the words, "The members of the Commission, when attending meetings of the committees of the Commission, shall be repaid their actual reasonable disbursements incurred in travelling to, returning from, and remaining at the meetings, or attending to the business thereof."

5. Section 12 of the said Act is amended by adding thereto the following subsection:—

"2. Any committee of the Commission may, with the approval of the chairman of the Commission, exercise all the powers conferred upon the Commission by this section."

6. Section 13 of the said Act is amended by adding thereto the following subsection:—

"2. In addition to the annual report the Commission shall report from time to time to the Senate or to the House of Commons, through the Speaker thereof, whenever directed to do so by resolution of the Senate or of the House of Commons, as may be."

7. The said Act is amended by adding thereto the following sections:—

"14. All mailable matter addressed to the Commission or to the secretary, at Ottawa, shall be free of Canada postage under such regulations as are from time to time made in that regard by the Governor in Council.

"15. No person appointed as secretary or as officer or clerk under him, or person employed as an employee for the purpose of any special work or investigation, shall, while appointed or employed as aforesaid,—

"(*a*) purchase, lease, acquire or obtain, on royalty or otherwise, any Dominion or provincial franchises, fishery rights, water powers, water privileges, lands, mines, mineral lands or timber limits, or in any way contract therefor or acquire any interest therein, either for himself or as agent for any other person or corporation;

"(*b*) locate military or bounty land warrants or land scrip, or act as agent of any other person in such behalf;

"(*c*) disclose to any person, except to members of the Commission, any

discovery made by him or by any of them, or any other information in his possession relating to matters under the control of the Commission, or in relation to their investigations, until such discovery or information has been reported to Parliament.

"16. Every person guilty of any violation of any provision in section 15 of this Act shall forfeit to His Majesty all property or interest so acquired or obtained, and shall also incur a penalty of one thousand dollars for each such violation.

"2. The acquisition of each item of property or interest therein or contract therefor, as aforesaid, shall be deemed a separate violation of the said section.

"3. Such penalties shall be recoverable on information filed in the name of the Attorney General of Canada, and a moiety thereof shall belong to His Majesty, and the other moiety thereof shall belong to the informer."

ORDER IN COUNCIL APPOINTING THE MEMBERS OF THE COMMISSION OF CONSERVATION.

Certified copy of the Committee of the Privy Council, approved by His Excellency, the Deputy Governor General, on the 3rd September, 1909.

The Committee of the Privy Council, on the recommendation of the Right Honourable Sir Wilfrid Laurier, advise, under the provisions of Chapter 27 of 8-9 Edward VII, "An Act to establish a Commission for the Conservation of Natural Resources," that a Commission be appointed to be known as "The Commission of Conservation," and that the same be composed of the following gentlemen, to be members ex-officio::

The Honourable Sydney Fisher, of Ottawa, Minister of Agriculture;

The Honourable Frank Oliver, of Ottawa, Minister of the Interior;

The Honourable William Templeman, of Ottawa, Minister of Mines;

The Honourable Francis L. Haszard, of Charlottetown, Premier of the Province of Prince Edward Island;

*The Honourable William Thomas Pipes, of Halifax, Attorney General of the Province of Nova Scotia;

The Honourable Ward Chipman Hazen Grimmer, of Fredericton, Surveyor General of the Province of New Brunswick;

The Honourable Jules Allard, of Quebec, Minister of Lands and Forests of the Province of Quebec;

The Honourable Frank Cochrane, of Toronto, Minister of Lands and Mines of the Province of Ontario;

The Honourable Hugh Armstrong, of Winnipeg, Provincial Treasurer of the Province of Manitoba;

The Honourable James Alexander Calder, of Regina, Commissioner of Education and Provincial Treasurer of the Province of Saskatchewan;

The Honourable Alexander Cameron Rutherford, of Edmonton, Premier and President of the Executive Council of the Province of Alberta;

*The Honourable Frederick John Fulton, of Victoria, Chief Commissioner of Lands of the Province of British Columbia;

The Honourable Benjamin Rogers, of Alberton, Prince Edward Island;

Professor Howard Murray, B.A., of Dalhousie University, Halifax, Nova Scotia;

Mr. Frank Davison, of Bridgewater, Nova Scotia;

Mr. Cecil C. Jones, M.A., Ph.D., LL.D., Chancellor of University of New Brunswick, of Fredericton, New Brunswick;

Mr. William B. Snowball, lumber merchant, of Chatham, New Brunswick;

Mr. Henri S. Béland, M.D., M.P., of St. Joseph de Beauce, Quebec;

Mr. Frederick Debartzch Monk, K.C., D.C.L., M.P., of Montreal, Quebec;

Doctor J. W. Robertson, C.M.G., Director of Macdonald Agricultural College, of Ste. Anne de Bellevue, Quebec;

---

* On the decease of Hon. Mr. Pipes, he was succeeded by Hon. A. K. Maclean as Attorney General of Nova Scotia and also, therefore, as a member of the Commission of Conservation.

* Since the passing of this Order in Council, Hon. Price Ellison has succeeded Hon. Mr. Fulton as Chief Commissioner of Lands and Works for British Columbia, and also, therefore, as a member of the Commission of Conservation.

Monseigneur J. C. K. Laflamme, Superior and Rector of University of Laval, of Quebec, Province of Quebec;

Sir Sandford Fleming, K.C.M.G., LL.D., M.I.C.E., Chancellor of Queen's University, of Ottawa, Ont.;

The Honourable Senator William Cameron Edwards, of Ottawa, Ontario;

Mr. Edmund Boyd Osler, M.P., of Toronto, Ontario;

Mr. Charles Arthur McCool, lumber merchant, of Ottawa, Ontario;

Mr. J. F. Mackay, journalist, of Toronto, Ontario;

Professor Bernard Fernow, of Toronto, Ontario;

The Honourable Clifford Sifton, K.C., M.P., of Ottawa, Ontario;

The Reverend George Bryce, M.A., D.D., LL.D., F.R.S.C., of the University of Manitoba, Winnipeg, Man.;

Doctor W. J. Rutherford, Deputy Minister of Agriculture and member of Faculty of the University of Saskatchewan, of Regina, Saskatchewan;

Professor H. M. Tory, M.A., D.Sc., LL.D., President of University of Alberta, of Edmonton, Alberta;

Mr. John Hendry, lumber merchant, of Vancouver, British Columbia.

The Committee, on the same recommendation, further advise that the Honourable Clifford Sifton, of Ottawa, Ontario, be chairman of the said Commission of Conservation.

(Sgd.) RODOLPHE BOUDREAU,
Clerk of the Privy Council.

COMMITTEES OF THE COMMISSION OF CONSERVATION.

Committee on Fisheries, Game and Fur-Bearing Animals:—Hon. F. L. Haszard, Chairman; Hon. Hugh Armstrong, Hon. Frank Cochrane, Hon. Price Ellison, Hon. W. C. H. Grimmer, Hon. A. K. Maclean, Dr. Howard Murray.

Committee on Forests:—Senator W. C. Edwards, Chairman; Mr. Frank Davison, Dr. B. E. Fernow, Mr. John Hendry, Mgr. J. C. K. Laflamme, Hon. Frank Oliver, Mr. W. B. Snowball; and the ex-officio members of the Commission who represent the various provinces.

Committee on Lands:—Dr. J. W. Robertson, Chairman; Dr. Geo. Bryce, Hon. Sydney Fisher, Hon. Benj. Rogers, Dr. W. J. Rutherford; and the ex-officio members of the Commission who represent the various provinces.

Committee on Minerals:—Dr. H. S. Béland ,Chairman; Mr. John Hendry, Dr. Howard Murray, Hon. W. Templeman; and the ex-officio members of the Commission who represent the various provinces.

Committee on Press and Co-Operating Organizations:—Mr. J. F. Mackay, Chairman; Hon. Jules Allard, Dr. Geo. Bryce, Dr. Howard Murray, Dr. H. M. Tory.

Committee on Public Health:—Mr. E. B. Osler, Chairman; Dr. H. S. Béland, Hon. J. A. Calder, Hon. Sydney Fisher, Sir Sandford Fleming, Dr. Cecil C. Jones.

Committee on Waters and Water-Powers:—Mr. F. D. Monk, Chairman; Hon. Jules Allard, Hon. Frank Cochrane, Hon. Price Ellison, Hon. W. C. H. Grimmer, Mr. C. A. McCool.

PROCEEDINGS

OF

THE COMMISSION OF CONSERVATION

AT

THE FIRST ANNUAL MEETING

OTTAWA, CANADA.

The inaugural address of the Chairman, Honourable Clifford Sifton, at the first annual meeting of the Commission of Conservation, held in the Carnegie Library, was delivered at 11 o'clock on the morning of January 18, 1910.

INAUGURAL ADDRESS.

In opening the meeting, Mr. Sifton said:—

Your Excellency and Gentlemen:

The occasion upon which we meet is one of very great importance. I need not say I am glad to welcome such a gathering as we have here this morning. I should, perhaps, say a word or two in regard to the preliminary arrangements for our meeting. The Commission was constituted by the Act which was passed at the last session of Parliament. There was necessarily a considerable amount of delay in the making of appointments to the Commission because communications had to be made with the gentlemen whose names were mentioned and the appointments were not completed, therefore, until late in the summer. When we returned for work in the fall, the first duty was to select a Secretary, who is the chief officer of the Commission, and whose appointment is, therefore, a most important one. After a good deal of deliberation and consideration we decided upon Mr. James White, who is now the Secretary of the Commission. I do not need to say to any of you who have had any experience of Mr. White's work that his appointment is one of the best we could possibly have made. Those of you who are not familiar with his work will become familiar with it in the future, and I have no doubt you will confirm the judgment of those of us who have been acquainted with his work in the past.

Then it was necessary to proceed with the organization of a staff. That, I may say, has been somewhat slow. The Secretary of the Commission, together with the Civil Service Commissioners, is giving his attention to the matter but the getting of the right kind of technically qualified men has not yet been successfully performed, except in the case of one member of the staff. The appointments, however, will be made in due course as soon as the proper men can be found. I may say that the Secretary of the Commission and the Civil Service Commissioners are giving their attention to the matter with the sole object of getting the men who are the best qualified for the work which we have for them to do.

Then there was the question of making the arrangements for this meeting. I had thought of calling a preliminary meeting of the Commission to arrange details of the meeting, but that, on consideration, appeared impracticable, and so I undertook the responsibility of making the arrangements myself with the co-operation of Mr. White.

It appeared to me that it would be well at this meeting to make some remarks indicating my own ideas as to the way in which the work of the Commission should be carried on, but I need not say that, in doing so, I have no idea of trying to impose my own views upon the Commission. On the contrary, what I desire is that the members of the Commission should make use of me in the fullest possible way for the purpose of carrying out their views in regard to the great and important subject which we have to consider.

We have met to-day under the mandate of the Parliament of Canada for the purpose of inaugurating a work which is fraught with most important consequences to the people, not only of our own generation, but of the future. Parliament has deemed it wise to constitute this Commission for the purpose of promoting the conservation of our natural resources. The Bill was introduced by the Government; it passed both Houses of Parliament without a division, and may, therefore, be taken to represent the unanimous view of all parties in the House of Commons and the Senate.

The Commission, it is to be noted, is exceptional in its character.

First, it is not a portion of the ordinary governmental administration for which the Government is politically responsible. It is a Commissoin created by Parliament and entrusted with certain duties, upon the performance of which it is to report from time to time. The funds necessary for carrying on the work must, it is true, be procured by application to the Government of the day, which will introduce the necessary estimates; but, otherwise, the work is totally independent of the ordinary administration of affairs.

FIRST ANNUAL REPORT.

Second, the Commission is constituted in such a way as to secure upon its membership three members of the Federal Government and one member of the Government of each Province, insuring, therefore, the presence of a sufficient proportion of members actually engaged upon and experienced in the details of administration in the various parts of the country.

Other provisions requiring the appointment of members from the Universities, provide for the presence of a considerable proportion of men who have attained distinction in connection with our scholastic institutions. It is, therefore, evident that Parliament has legislated with the object of securing upon the Commission a high degree of scholarship, of scientific knowledge and of administrative experience in order to ensure the work being successfully undertaken.

Having accepted this important public trust, it becomes our duty to unite in discharging our responsibilities with whole-hearted enthusiasm and with single-minded determination to advance the public interest in every way possible within the legitimate scope of the powers conferred upon us.

The Commission is not an executive nor an administrative body. It has no executive or administrative powers. Its constitution gives it power to take into consideration every subject which may be regarded by its members as related to the conservation of natural resources, but the results of that consideration are advisory only. In a sentence, the Commission is a body constituted for the purpose of collecting exact information, deliberating upon, digesting and assimilating this information so as to render it of practical benefit to the country, and for the purpose of advising upon all questions of policy that may arise in reference to the actual administration of natural resources where the question of their effective conservation and economical use is concerned.

The effectiveness of our work will depend upon its own merits. We can only study, investigate and advise. The Governments concerned must take the responsibility of accepting or rejecting what we recommend. So far as the

work consists in collecting and digesting information, it will, in any event, be of great value. When it comes to the acceptance by Governments of specific recommendations for action, or the adoption of policies, then the strength of the advice, its effectiveness and influence, must depend upon its own inherent and obvious wisdom and the soundness of the reasons advanced in its support. Obviously, therefore, there will be no room for haphazard conclusions or careless or unscientific work. Each question dealt with must be approached with an absolutely open mind and an unyielding determination to make the investigation thorough and complete and to reach the best possible conclusions. If the work be undertaken in such a spirit, it may reasonably be hoped that it will bear important fruit. The men who are in charge of the administration of our natural resources are, we may assume, desirous of giving the best administration possible. But it is most difficult for them always to know what is best. The subjects are complicated and the information necessary to a really intelligent conclusion often widely scattered, difficult to procure, and of such a character as to require much time and long study to digest. This is peculiarly true in Canada—a country of sparse population and of immense resources yet comparatively little known. One man, in Canada, is often charged with the administration of resources so vast in extent that it is difficult for him to gain even the most cursory knowledge of the details of his own department. The life of the political head of a Department under our system, is a strenuous and busy one. He may often recognize that there is need for progress and improvement, but it takes time to work out the lines of such progress. Further, he is often deterred by the fear of hostile criticism, to which he could only oppose his own individual opinion. His motives are criticized and the wisdom of his measures impugned. Thus the boldest administrator, sooner or later, becomes disposed to adopt the policy of *laissez faire*. Under such circumstances, competent and disinterested support in carrying out the needed measures of reform ought to be welcome, and if, by the publication of the results of the work of this Commission, a strong and intelligent public opinion has been created in support of such measures, the way is made easy for their adoption.

One further word in regard to the methods and principles of action to be adopted in carrying out our work. It is absolutely essential to make it clear that it is not the province of the Commission, and it will not be its practice, to interfere with, to hinder, or to belittle the work of any other bodies, persons, associations or institutions. Our province should be to help, not to hinder. Where any person, organization, association or institution is engaged in doing work looking to the same result as that which we are aiming at, viz., the conservation of natural resources, it is our duty to support that work by every means in our power. There is no room for jealousy, there is abundant scope for all. There should be a community of interest and a harmonious co-operation all along the line, resulting in a great and strong movement for the adoption of the most effective policies.

The history of the movement which has resulted in our meeting is comparatively brief. The President of the United States having appointed the Inland Waterways Commission of the United States, that Commission on October 3rd, 1907, addressed to the President a memorandum suggesting that the time had arrived for the adoption of a national policy of conservation, and suggesting that a conference of the Governors of the States of the Union should be held at the White House to consider the question. The President acted upon the suggestion, and the Conference, duly summoned by the President, met at the White House in May, 1908. Leading publicists in the United States declared that no more important gathering had ever taken place on the continent. It comprised not only the Governors of the States, but members of the United States Cabinet, Members of Congress, Justices of the Supreme Court and many distinguished

scientific men. A declaration of principles was adopted and steps taken to promote joint action between the Federal and State Governments. Later, a National Commission was appointed, which proceeded to make perhaps the first and only attempt to formulate an inventory of the natural resources of a nation.

Following this action, President Roosevelt, recognizing that the principles of the conservation of resources have no international limitations, invited the representatives of Mexico and Canada to meet at Washington in a joint North American conference. This conference adopted a declaration of principles, copies of which have been furnished to you. Upon the receipt of the report of the Canadian delegation, our Government determined to adopt the recommendations contained in that declaration of principles, and to constitute a permanent Commission of Conservation.

In determining the lines upon which action should be taken, it was recognized that there was grave danger that the authorities of the Provinces might look with jealousy upon any Commission created by Federal legislation, and the provisions of the Act were expressly framed in such a way as to preclude the possibility of any ground for such a feeling, the representation being, in fact, such as to secure, as far as possible, the most effective representation of the views of each Province. The Commission is, in fact, probably the most truly national in its composition of any body that has ever been constituted in Canada.

If I may be permitted to make a personal reference, I desire to say that, so much impressed have I been with the importance of this consideration that I determined, when accepting the position of Chairman, to dissociate myself altogether from active participation in party political affairs, believing that the work of the Commission will occupy a great share of my time and attention, and that, by such a course, I can reasonably hope to secure the complete and hearty co-operation of all the members of the Commission.

I must admit that, although I have, during the greater portion of my life, made it my business to become acquainted, as far as possible, with the natural resources of our country, the most pronounced feeling that I have experienced in attempting to realize the scope of our work has been one of utter inability to do so. The least consideration of any class of resources impresses one painfully with the inadequacy of his intellectual equipment to grasp the significance of a subject where each minute branch is properly the work of a lifetime of expert and highly specialized research. Nevertheless, it is our duty to address ourselves to the work courageously, trusting that painstaking and systematic labour will bring satisfactory results.

Some general considerations are at once apparent from an examination of existing conditions. It is evident, for instance, that our circumstances differ materially from those of the United States in important particulars. There they have a large population, and the development of their resources has proceeded very far. In our case the facts are different. Our population is sparse, our resources only in an initial state of development. So much so is this the case, that I have heard the view expressed that what Canada wants is development and exploitation, not conservation.

This view, however, is founded upon an erroneous conception, which it must be our work to remove. If we attempt to stand in the way of development, our efforts will assuredly be of no avail either to stop development or to promote conservation. It will not, however, be hard to show that the best and most highly economic development and exploitation in the interests of the people can only take place by having regard to the principles of conservation.

It is further evident, from an examination of the publications relating to the work in the United States, that many of the lines of policy which have resulted disastrously there, have not been followed at all in Canada. As a

fact, the policy followed in Canada in some cases is that which the United States are now trying to reach. A notable case of this kind is the disposition of the timber lands. In the United States the policy has been to sell the timber lands outright, which removes the land and timber from Government regulations. Forest experts deplore the fact that the great bulk of the timber in the United States is now privately owned, and that the local taxation, based upon totally uneconomic principles, is made so heavy that it becomes an incentive to the timber owner to clear off the forest and to realize on it as quickly as possible by the most destructive methods.

In Canada, on the contrary, the amount of timber land privately owned is comparatively trifling. Only, I think, in the province of Quebec is it a factor. Our Governments—Federal and Provincial—have followed the policy of leasing the right to cut timber under regulations which permit the most absolute control by the Governments concerned and preserve the right to alter the regulations from time to time. There is, therefore, in the state-owned timber lands of Canada—Provincial and Dominion—a free field available for the adoption of improved regulations.

Another respect in which our position differs, to our great advantage, from that of the United States is that the lands surrounding the head-waters of some of our greatest and most important water courses are still in the ownership of our Governments, so that extensive reserves can be made with little expense to the public treasury.

As an illustration of the importance of this fact, it may be mentioned that, for the last twenty-five years, it has been recognized in the United States that forest reservations were necessary to protect the head-waters of the streams that arise in the Appalachian mountains. Thousands of newspaper and magazine articles have been written on the subject. Bills have been introduced into Congress: influential associations and deputations have implored Congress to take action: Presidents have recommended it: but no action has yet been taken. So difficult is it to secure intelligent attention to a subject which involves the welfare of whole states, once the land has passed from Government control.

Where the scope is almost infinite the effort should be to choose that which is immediately practical and useful. And, first of all, it appears clear to me that provision should be made for making a comprehensive and accurate inventory of our natural resources, so far as our available information extends. The beginning of all proper investigations is the ascertainment of facts, and there is no country that I know of where it is more urgently necessary in the public interest that the natural resources should be tabulated and inventoried than it is in Canada. When the Commission was appointed by the Canadian Government to go to Washington last winter, we set on foot a preliminary movement to tabulate information. The results of that work are now among our records. It is, I may say, of the most fragmentary description. It was surprising to find how difficult it was to get anything like accurate information. Statistical information of the class which our census officers prepare is abundant and accurate, but it does not assume to deal with the question of natural resources. At the present moment there are but few publications of any Government in Canada which give accurate and comprehensive information upon these subjects.

The utility of such an inventory hardly needs discussion. Both for the purposes of development and of conservation it is the first essential to have an accurate and complete statement of the facts, readily available, accessible to all, and couched in language that the average reader can understand.

You have no doubt made yourselves familiar with the declaration of principles adopted by the North American Conservation Conference at Washington.

Let me quote from it one paragraph which, I think, should be regarded as embodying the guiding principle of our work.

> "We recognize as natural resources all materials available for the use "of man as means of life and welfare, including those on the surface of "the earth, like the soil and the waters; those below the surface, like the "minerals; and those above the surface, like the forests. We "agree that these resources should be developed, used and con- "served for the future, in the interests of mankind, whose rights and duties "to guard and control the natural sources of life and welfare are inherent, "perpetual and indefeasible. We agree that those resources which are "necessaries of life should be regarded as public utilities, that their owner- "ship entails specific duties to the public and that, as far as possible, effec- "tive measures should be adopted to guard against monopoly."

Let it be understood, that in this declaration, there was no intention of reflecting upon any government or upon any person. There is probably no government in North America and no man for any considerable time connected with administration of public affairs, as a representative or as an administrator, who has not frequently been a party to measures inconsistent with this declaration of principles. But it is only by recognizing the neglect and omissions of the past and by endeavouring to avoid them in the future, that progress can be made. The object in framing this declaration was to embody the results of experience and the highest wisdom attainable. The laws and the practice, as they exist to-day, are far from conforming to these ideal principles, but the ideal is our guiding star, and, towards its attainment, we should devote our most strenuous efforts.

The natural resources may be grouped generally under a number of headings:—The Minerals, The Fisheries, The Public Health, Inland Waters, The Land and The Forests.

Minerals—Up to the present moment, in the history of Canada, the sole effort has been to secure the exploitation of our mineral wealth. There is no reason why such exploitation should be discouraged; but there is every reason why intelligent consideration should be given to the more economic use and production of minerals. Improvement in methods of production may mean scores of millions added to the available mineral wealth and long continued enjoyment of the results of mineral production. Improved methods of saving and separating minerals will result in great quantities of mineral being profitably used which are now consigned to the refuse heap. The various Provinces have departments which have the care of their mining industries. The Dominion also has established a Department of Mines. The Dominion Deprtment of Mines has lately been devoting attention to the issuing of useful reports containing exact information upon a variety of subjects. Investigations of an important character have been undertaken. Questions relating to processes for more satisfactory and economical extraction of ore are constantly arising. There is always the difficulty, however, that the Minister or official, whether in the Province or in the Dominion, who strives to advance, is faced with the difficulty, not only of doing his ordinary and usual work, but of overcoming the natural inertia which opposes itself to progress and the adoption of new and advanced ideas. A careful survey of the work done by the various Departments of Mines will undoubtedly result in making clear the lines of practicable progress, stimulating co-operation between the different departments, strengthening the hands of those who desire to follow a progressive policy, and also, which is hardly less important, eliminating classes of work, the utility of which is not apparent.

It would be quite outside of my scope to undertake to speak at large upon the mineral resources of Canada. Let me mention a few salient facts.

1. In 1905, the mineral production of Canada was 20½ millions.
In 1908, the mineral production of Canada was 87 millions.

2. If you look at the geological map of Canada, you will see that the development has taken place, practically, (leaving out the Yukon) only in territory lying fairly near to the southern boundary, that is, to the inhabited and settled territory.

3. Wherever prospecting has been done farther north, indications of valuable minerals have been found, and, by accident, great wealth has been uncovered in some cases.

4. Our whole country north, from Ungava to Yukon, is of a geological formation which renders it almost certain that it is rich in valuable minerals.

5. There are in the province of Ontario, large bodies of certain classes of iron ore which are, at present, useless. They can be utilized, so far as our present knowledge goes, only by the introduction of electric smelting. The water-power is abundantly available. Our Government has taken the lead of all the governments of the world in the investigation of the subject. Economic plants for electric smelting of iron ore are now being established in Norway and Sweden. We have led the way in investigations, but we are behindhand in the application of the knowledge acquired. A great industrial development lies ahead of Canada in connection with this subject. Our Government should be urged to spare no effort in its encouragement.

Waste prevails to a very large extent. Let me illustrate,—

1. In the Cobalt camp the mine owners are largely at the mercy of foreign smelters and refiners.* Much valuable mineral is taken and not paid for or accounted for. It is lost to the owners and to this country because there is no effective method of treating these ores in Canada. Thorough investigation by experts is highly necessary. Probably the valuable mineral lost in the Cobalt camp in one year would pay for the whole investigation, and build the plant necessary to treat the ores under proper guarantees.

2. In the utilization of coal deposits, most wasteful methods are employed.† Coal difficult to mine, is not taken out and the shafts are blocked up and the deposits lost forever; so of iron. In making coke it is alleged that uneconomic methods largely prevail.

3. In British Columbia, until lately, no account was taken at all of zinc contents in the ores, and a large amount of this very valuable metal was lost. The Federal Department of Mines has investigated the subject, but further action is necessary.

4. In the Yukon, large deposits of gold-bearing gravels have been covered by tailings and rendered extremely expensive or impossible to work.

5. Upon the subject of mine accidents I speak subject to correction; but my information is that Canada makes almost the worst showing in the world. The fatality rate in coal mining in the United States and Canada appears to be steadily increasing. Increased knowledge, scientific development and modern methods are apparently not being devoted to protecting the lives of helpless employees.

In the Transvaal, with Kaffir labour, the death rate in 1906 was 5 per

*The present position is that, owing to recent improvements, the provision for treatment of high-grade ores in Canada is now fairly good. The low-grade ores are still sent to foreign smelters.

†This remark does not apply to coal mining in Nova Scotia.

1,000 employees employed underground. This was considered so great that a Royal Commission was appointed to enquire into it. In the Cobalt district in 1908, I am told the death rate was 24.8 per 1,000* employees employed underground, or nearly five times as great as among the Kaffir labourers of the Transvaal.

Much of this is, no doubt, due to the fact that Canadians have not, until the last few years, been a mining people. New mining districts have been opened up in great haste. Work has often, almost of necessity, been placed in incompetent and inexperienced hands. This has been, perhaps, to some extent, inevitable in the early stages of mining development. But we do not desire that, in Canada, the rush for the wealth of the mines should be characterized by the same coarse disregard of human life that has been evident in some other countries. We have got far enough now to take stock of the position and adopt a forward policy. If a man is employed to take charge of a boiler and engine on a small steamboat, he requires to show that he has passed a rigid examination as to his qualifications. Is it not equally necessary that there should be a standard of qualification for the man who takes charge of the development of a mine, where the lives of employees are constantly at stake? While it is most undesirable that the mining industry should be too much hampered by governmental interference, public opinion would surely, in view of the above figures, support the Government in going much farther in the way of regulation and inspection.

Fisheries—This is one of the greatest of our national resources, the means of livelihood of a large and important branch of our population. No effort should be spared to promote its perpetuation and continuation. Ever since Confederation there has been a department especially charged with the duty of conserving the fisheries, and extensive expert investigations have repeatedly been made. A Committee on Fisheries has lately been added to the list of select standing committees of the House of Commons, and I believe that efforts are made in the selection of the members of that Committee to appoint gentlemen who are familiar with the subject. Some of the Provinces also have Departments who are charged with the care of the fisheries and pursue an active policy. It will be a matter for you to decide as to what course can best be adopted to strengthen the hands of those who are charged with the important duty of dealing with this subject.

Public Health—The physical strength of the people is the resource from which all others derive value. Extreme and scrupulous regard for the lives and health of the population may be taken as the best criterion of the degree of real civilization and refinement to which a country has attained. It cannot be said that it has received too much attention, though the Provinces, the Dominion, and the municipalities have health laws and health administrations all doing effective and useful work. There are, however, many branches of the subject, general in their character, which merit attention.

---

* The figures respecting Mining Accidents in the Cobalt district were based upon the Eighteenth Annual Report of the Bureau of Mines of Ontario, 1909, Volume XVIII, Part I. On page thirteen appears the following statement:—

"The number of men employed in the silver mines of Cobalt, including also those engaged in the works for the reduction of ores at Copper Cliff, Deloro and Thorold, was 2414. The amount paid out in wages, $2,159,055.00. Of these 1089 were under ground workers and 1325 above ground."

Another portion of the Report shows that there were 27 fatalities underground in the silver mines of Cobalt.

It has since transpired that the above quoted statement is not strictly accurate, and was intended to apply to "producing" mines only. The Deputy Minister of Mines of Ontario states that the correct figures would be a little less than 12 per 1000 of those employed underground.

The Dominion spends hundreds of thousands of dollars in eradicating the diseases of animals, and the work, it is pleasing to know, is being done with thoroughness. But no similar effort is made by Province or Dominion to meet the ravages of diseases among human beings, such, e.g., as tuberculosis. Lately this subject was brought before the House of Commons by Mr. George H. Perley, M.P., and an illuminating debate followed. It is probable that Parliament would readily consent to the necessary appropriation for undertaking to deal with the evil. This, however, is one of the subjects upon which Federal and Provincial jurisdictions overlap, and in which any effective action will require to be carefully worked out and agreed to between all the Governments concerned. A sub-committee from this Commission, representing as it does, all the Governments, might well be able to work out an acceptable and useful plan which would receive general assent.

Other questions, such as the pollution of waters and streams, demand attention. There is a Bill at present before the Senate, dealing with this question, to which, it is understood, some of the municipalities affected to object. A study of the question will, no doubt, reveal the best method of dealing with it so as to obviate disputes and accomplish the desired results.

Waters—Rainfall and snowfall are the sole sources of our supply of fresh water. It is the universally essential natural resource. It is as essential to life as the heat of the sun.

Canada is exceptionally favoured in that there is no part of its great area which, under natural conditions, is entirely arid. It will be our own fault if it becomes so, as it will, in some portions, unless preventive measures are taken in time.

Of the total supply of fresh water which descends in the form of rain and snow, perhaps one-half is evaporated, about one-third finds its way to the sea, and the remainder, about one-sixth, is used.
Waters are used for:—

1. Human and animal use to sustain life.
2. For vegetable use to sustain vegetation and render agriculture possible.
3. For navigation.
4. For power.
5. Under modern systems of sanitation, we make use of water for flushing sewers, carrying away and destroying the most valuable of fertilizers, and at the same time polluting the water into which it is carried. This may be characterized rather as a monumental misuse than as a use of water.

The practical utility of water for domestic purposes is measured by its purity. When polluted, it becomes the worst of all sources of disease. In our present state of civilization it would be thought that, at least, we would be careful to provide pure water. Such is not the case. In this city at the present time, families who are especially careful are buying water for drinking purposes, while Montreal is struggling with a serious outbreak of fever, probably the result of the use of impure water.

The utility of the streams for the purposes of power and navigation is measured by the volume at the low-water stage. At the high-water stage, the excessive flow is wasted, and, not only so, but it always does serious damage. The damage is not, as popularly supposed, measured by the destruction of houses, buildings, fences and other visible property. The more serious damage is by the erosion of soil and consequent loss of fertility.

Most of the rainfall and snowfall which does not evaporate or run to the

sea remains in the soil. This water is essential to the production of vegetation. Without it, crops become an impossibility. When the supply is lowered beyond the necessities of the crops the fertility and productive power are lowered. It is popularly supposed that nature regulates this. So it does, but under the influence of conditions created by man, and, where evil conditions are allowed to arise, the necessary supply of ground-water diminishes. It is, for instance, a known fact that, in certain upland parts of the eastern United States the average level of the ground-water, that is, the water held in the soil, has fallen by from 10 to 40 feet, while springs and wells have permanently failed. In these districts thousands of abandoned farms are to be found.

While the stock of water from rain and snow cannot be increased, the quantity available for use can be greatly augmented:

1. By methods of agricultural treatment which diminish the run-off and hold the proper quantity for absorption by the soil.

2. By catchment areas which prevent the spring freshets, obviating the destructive force which results in erosion, and making use of the water stored to supplement the flow in seasons of low water. Works of this character are now being constructed on the upper reaches of the Ottawa, and similar works will undoubtedly be required in many sections of the country. These works are essential to securing the full and proper use of our natural advantages in water supply. It is not an academic question, nor one to be relegated to the distant future. A little investigation will show that a surprisingly large and increasing number of our streams do great damage by spring freshets, and are rendered of little service for power purposes by the meagreness of the flow in low water.

3. By preserving forest growth which furnishes the best possible reservoir.

Recognition of the above facts, and action upon them, to be useful, should be brought about without undue delay. Enormous development will take place in Canada during the next few years. It should proceed on lines that will conserve, improve and increase the water supply, rather than diminish it.

One of the greatest industrial developments of our time consists in the utilization of water by means of electrically transmitted power. The flowing waters of Canada are, at the moment, apart from the soil, our greatest and most valuable undeveloped natural resource. They are more valuable than all our minerals, because, properly conserved, they will never be exhausted; on the contrary, they can be increased. In great areas of our country they are capable, when fully developed, of supplying our entire urban population with light, heat and power, operating our tramways and railways, and abolishing the present methods with their extravagance, waste and discomfort. The time when this dream will be realized need not be, and probably is not, far distant.

What are to be the conditions under which this development will take place? Is this great national boon to be handled in such a way that the people shall forever continue to pay tribute and interest upon the continually growing unearned increment of value, or is the development to take place under conditions that will ensure due economy, full utilization, reasonable rates and a participation by the people in the profits?

The subject is comparatively new in Canada. Few vested rights exist. The field is, therefore, comparatively an open one for intelligent legislative effort. The old common law of England, the principles of which, in the main, regulate the rights to waters, is largely inapplicable to modern conditions under which water and its uses have become of prime importance. The subject requires to be dealt with by legislation in a fundamental fashion.

In California, where the use of water is a necessity of agriculture, a great body of water-right law has been built up. The people found it necessary to

deal with the subject in the public interest, and they have done so. In Canada, the time has arrived when the subject should be considered, and when the rights of the public to water and the use of it should be defined.

I know of only two instances in Canada where this subject has been approached and dealt with in a progressive spirit. The first is the case of the provinces of Alberta and Saskatchewan, in which, by the Federal North West Irrigation Act, passed before the provinces were formed, the waters are vested in the Crown and can only be taken and used for irrigation under license.

The second illustration is found in the province of Ontario, the Government of which Province has the credit of being the first to inaugurate a really progressive policy in regard to water-powers. I understand that conditions are inserted in the leases of water by that Province, protecting the interests of the public. Further, a policy has been adopted, under the operation of the Hydro-Electric Power Commission, of giving the people the greatest possible benefit from the possession of water resources. I am glad to say that, during the session of this Commission, we shall have an authoritative statement from a member of the Ontario Government as to the exact scope of the policy.

For myself, I am free to say that I think the necessities of the case demand further and more radical action. It is open to serious question if the time has not arrived when all water-power development should be under the control of the Governments concerned, requiring a license for development, and subject to general laws making regulations in the public interest, and taking a share of the profits for the public treasury with power, in the future, to readjust tolls.

Let me give you a striking illustration of what is ahead of us if this is not done. It is not in the densely settled east, but in the West where one would think that such a state of affairs had hardly, as yet, sufficient time to develop.

> "The Central Colorado Power Company now claims as its market an "area from Grand Junction on the west, to fifty miles east of Denver and "100 miles north and south of this line—an area of 50,000 square miles, a "commonwealth in itself.
>
> "In this area this Company, holding the best powers, with sufficient "power already in process of development to supply the demand for years, "and with its command of the market referred to, controls the territory for "the present, but also for the future development as well, since there will "be no possibility of equality of competition for future competitors, either "in meeting the cost of producing power or in obtaining equal marketing "facilities."
>
> *Boston* (Mass.) *Traveller.*

A present necessity in this connection is an agreement between Federal and Provincial Governments as to the limits of their respective jurisdictions. Such an agreement should be easily arrived at, and it would be more seemly and more in the public interest that it should come about by an amicable agreement than be reached through prolonged and expensive litigation, which may result in a determination founded upon technical principles of law remote from any consideration of public convenience and interest.

The water-powers of Canada are extensive and widely distributed. The reports of the Hydro-Electric Power Commission, so far as they have gone, deal satisfactorily with Ontario; but anything like an accurate estimate for the whole country has never been made. The best information at present available, points to the following figures as approximately correct:—

	POSSIBLE. H.P.	DEVELOPED. H.P.
Yukon	470,000	3,000
British Columbia	2,065,500	73,100
*Alberta	1,144,000	1,333
*Saskatchewan	500,000	.....
Manitoba	504,000	18,000
North West Territories	600,000	none.
Ontario	4,308,479	331,157
Quebec (exclusive of Ungava)	6,900,000	about 75,000
New Brunswick	150,000	no records available.
Nova Scotia	54,300	13,300
Total	16,696,279	514,890

At 22 tons of coal per horse-power per annum (24 hours) the total possible horse-power is equivalent to 367,318,118 tons of coal per annum. The horse-power actually developed—514,890—used to the full extent, will displace 11,327,580 tons of coal per annum. The development in Ontario alone, utilized to the full extent, will displace no less than 7,285,454 tons of coal annually.

Let me call your most particular attention to the fact that water-power at the present time, in the infancy of its development, furnishes the equivalent of nearly the entire quantity of coal consumed in Ontario.

Ontario, it is to be noted, imports its coal from the United States. Last year the quantity imported was:

Bituminous	6,635,388 tons.
Anthracite	2,035,117 tons.
Total	8,670,505 tons.

This includes the quantity brought in through Port Arthur and Fort William for western use. The supply of coal in the United States is being used up with tremendous rapidity, and though, in our generation, there is no possibility, of exhaustion, there is not only the possibility, but the certainty, that increasing scarcity and expense in production will greatly enhance the cost to our consumers within a very few years.

Upon the subject of water-power development, we, in Canada, are distinctly behind the times. It may be surprising to some, as it was to me, to find that little Switzerland to-day leads the world in the development of water-powers, both in regard to advanced legislation on the subject, and also, though, perhaps not so decidedly, in regard to the economical and successful development and use of power. In an interesting and able publication by Mr. Charles Mitchell, C.E., of Toronto, containing an account of his study of European installations, I find the following:—

"In that branch of engineering science devoted to the development of "hydraulic works and equipment for the generation of power, European "engineers undoubtedly lead."

And again, he says that:—

"Viewed from the hydro-electric standpoint of engineering, Switzer-"land undoubtedly has led all other countries, and it is there the engineer "must go, even to-day, to obtain ideas as far ahead of American as are the "European fashions."

*Unfortunately, in Saskatchewan and Alberta, most of these powers are somewhat far removed from the settled portions of the Provinces.

If this is the verdict of the engineer, the verdict of the lawyer must be equally decisive in favor of the pre-eminence of Switzerland. Her people found themselves, like Ontario, paying enormous tribute to foreign countries for coal: they found that their water-powers were hampered in their development and in danger of being monopolized by defective laws. They went to the root of the matter; had it fully and carefully investigated by a commission of jurists and experts, and submitted a constitutional amendment which was ratified by referendum, and thus placed the law upon a workable and satisfactory basis.

This constitutional amendment gave the Federal Congress greater powers, but I do not suggest that here it is necessary that greater powers be given to our Federal Government—that is not what, in our case, is required. What we require is that we should proceed in the same business-like and systematic way as Switzerland has done, and secure a clear and definite agreement, settling doubtful points and leaving the way open for systematic and progressive legislation, under which all development will be properly regulated in the interests of the people. If anyone doubts the necessity of such an arrangement, let him consider the position which we find existing to-day, under which the holders of a Dominion charter are claiming the right to exploit a stream in defiance of the Government of the Province, and municipalities have already been involved in litigation on the subject.

Forests—When the Federal Government established a small Forestry Branch a few years ago, it is said that there was not employed, at that time, in the Dominion of Canada a single educated forester. Since that time there has been progress. A number of skilled foresters are in the employ of the various Governments, and much careful and conscientious work is being done. Chairs of Forestry have been established, and many young men are qualifying themselves for scientific forestry. The Canadian Forestry Association, formed a few years ago, is constantly labouring to arouse public interest in the subject. Yet it must be said that, in regard to this, the greatest and most available field for the conservation of an important natural resource, the work is only beginning.

The outstanding and important fact is that, in the last ten years, enlightened public opinion has clearly grasped the necessity for the conservation of the forests, and we can rely upon such public opinion being unanimous in support of all well-considered measures having that end in view. Frequent public discussions during the last few years have rendered the main facts to be considered fairly familiar. I shall not burden my remarks with statistics upon the subject of our supply of merchantable timber. The figures obtainable at the present time are far from accurate or reliable. It is certain, however, that the quantity of merchantable timber in Canada, outside of British Columbia, is much less than was popularly supposed up to a short time ago. It will be one of our first duties to thoroughly sift and supplement the presently available statistics and prepare a full and reliable statement.

A few facts stand out very clearly:—

(1) Under the policy adopted by our Governments—Provincial and Dominion—the timber lands leased to operators are still subject to the fullest regulation by the Governments concerned. The field is open, therefore, for improvement in regulations.

The generally admitted evils in the present methods of lumbering are:—

(a) Destruction of young growths.

(b) Cutting of trees not sufficiently matured.

(c) Leaving of inflammable refuse and débris upon the ground.

(2) The great foe of the forest is fire. A good deal has been done in the way of fire protection, but much more requires to be done. Notwithstanding everything that has been said and written on the subject, and the measures of prevention taken, it remains a fact that the devastation of forests by fire is going on at a rate that is simply appalling when one considers the ultimate and not far distant result. It is doubtful if one person in ten thousand realizes the actual meaning of even the partial and fragmentary information which we have on this subject. I commend to the attention of the members of this Commission a careful perusal of a little book issued by Mr. J. F. Whitson, O.L.S., of the Ontario Department of Lands, Forests and Mines, 1908, in which the subject is ably dealt with.

Tree planting in the west is important; the renewing of the white pine forests is important; the pulp-wood question is important; many other phases of the question are important, but the all-essential thing in regard to the question of forests is to get the community wakened up to the idea that an absolutely new departure must be made and at any cost the destruction of forests by fire must be stopped.

On a certain night during the past summer, I was in a log mining camp in one of the northern mining districts. The men in charge of that camp were up all night watching and fighting fires to prevent the destruction of the camp. On three sides as far as could be seen the fire was raging in a country covered with forest. It destroyed not only the timber, but the young growth and the covering of moss and forest mould, which is the only thing that sustains vegetable life on those hills. In that district the soil covering is very thin, and, once the fire goes through, there is nothing left but the barren rocks interspersed with lakes. For such destruction there is absolutely no excuse, and the most drastic enforcement of the law should be had to prevent it. A few striking examples will quickly disseminate the knowledge that no mercy will be shown to those who violate the law in this respect, and the fires started by careless prospectors and miners will cease. A sure reward in public recognition and gratitude awaits the man who will initiate such action.

(3) While the conservation of our actual supply of merchantable timber is important, yet of equally great importance is the treatment of the land, properly described as forest land, upon which there is at present no merchantable timber standing. These lands are many times larger in extent than those occupied by merchantable timber. They are, at present, excepting a few districts like the Algonquin Park, very largely neglected. The presence of a forest growth upon these lands is an absolute essential to the continued prosperity of the country. They conserve and regulate the water supply of our rivers. Without them we shall have, as they now have in many parts of the United States, destructive floods in the spring, followed by low and contaminated water all summer.

Without the protection of the forest growth and vegetable covering upon the soil the regular and even flow of our rivers will be forever a thing of the past. This is not a problem of the far distant future; it is a problem of the present. We have already reached the beginning of the results of deforestation promiscuously carried on. Within a few years we have seen on the St. Lawrence, Niagara, and Ottawa, extremes of high and low water of which we should take notice. The Federal Government is even now constructing extensive conservation works at the head-waters of the Ottawa. Artificial works, however, can only supplement, never supply, the place of nature in the regulation of stream flow.

There are some practical steps which can be taken at once, and which are of the utmost immediate importance. At the last session of Parliament the

select standing Committee on Forests and Waterways investigated the question of the flow of water from the east slope of the Rocky mountains through the plains of Alberta and Saskatchewan. It was shown in evidence before the Committee that, to preserve the water-supply of those Provinces, it was necessary to prevent the destruction of the timber upon the east slope of the mountains. It was shown that the destruction of the timber meant the disappearance of the regular water-supply of those Provinces, the agricultural production of which is the pride and the hope of Canada. It was further shown that by proper steps, not only can the present available supply of water be conserved, but that it can be greatly increased. Accordingly, the Committee recommended that practically the whole of the forest lands of the east slope of the mountains, which are still under the control of the Government, be formed into a permanent forest reserve, be placed in charge of a competent warden with a sufficient staff of assistants, and that it be governed by careful and stringent regulations.

Within the last few days I have been informed that the Government has decided to act upon the report of the Committee, and that a Bill for the purpose is now in course of preparation by the Minister of the Interior.

In the northern district of Ontario there is need of action. Of late years, the Governments of Ontario and Quebec have set apart large forest reserves. I am not fully conversant with the policy pursued by Quebec, but I understand that the Government of that Province has lately initiated an advanced policy on the subject, and has been conducting expert investigations into the question of preserving the source of supply of head-waters. We shall have a discussion of that subject from one of our members who is thoroughly competent to speak upon it. The Government of Ontario is pursuing a progressive and praiseworthy policy, having for its object the conservation of its valuable merchantable timber. The principal obstacle in the way of carrying out this policy is destruction wrought by fire. The enactment of more stringent laws on this subject should be considered.

But there is a field for work in the northern districts of Ontario in relation to the territory which does not bear high grade merchantable timber. Consider the position of the vast region stretching from Sudbury to Port Arthur and lying to the south of the height-of-land. A comparatively small part of this great tract bears merchantable timber. A further very small fraction is fit for cultivation. As to all the rest, apart from minerals, the only use to which it can be put is the growth of timber. So far as can be ascertained, prior to 1850, this tract was probably covered with timber, most of it of merchantable value. Fires, sometimes running for hundreds of miles, have travelled over it.

I quote from the above-mentioned pamphlet of Mr. Whitson.

"To-day you will scarcely find a township in the white and red pine "country that has not been burned, or partly burnt over, and, in many "instances the fire has swept over them several times.

"The fire of 1871 started almost at every point of the compass along "the north shore from French River to Kaministikwia on Lake Superior.

"This fire swept with fierce energy over an area of more than 2,000 "square miles, leaving blackened and giant pines to be a reminder for more "than half a century of the immense destruction there and then caused, "converting a virgin forest into a barren and desolate wilderness."

He refers you to a fire of 1855,

"which burnt easterly to the shores of Lake Timiskaming, up the "Montreal River to its source, and westerly along the height-of-land for "over 200 miles, to near Michipicoten." Two thousand square miles were devastated. I give these brief quotations as a slight indication of what has taken place.

Particularly since railway construction began, the greater portion of this tract has been, and is being, repeat dly burned over. If you look through the car windows as you travel through it, you will see stretches of bare and rocky hillside followed by brulés, followed again by tracts upon which extensive young forests of jack-pine rise to the height of ten, fifteen and twenty feet. But over this country fires are repeatedly passing, and the territory is quickly and surely getting to the point when every vestige of forest will be gone. Following this comes the stage in which, robbed of the protection of the trees, the vegetable mould and moss, which is the only covering of the rocks, dries out and becomes inflammable. Then it burns. It is happening every year. I could show you places which, within thirty years, were covered with forest, where the successive steps have taken place, and nothing remains but the bare rocks. There is nothing more absolutely certain in nature than that, unless steps are taken to protect it, the whole territory mentioned, with the exception of the few and small tracts fit for agriculture, and occupied as such, and small settlements along the railway, will be completely denuded, not only of trees, but of the soil, within the lifetime of men now living. No one can tell the physical effect on climate of such a catastrophe, but, apart from that, the mind shrinks from the very idea of such a rocky waste in the heart of the country.

My information is to the effect that the fires are almost wholly caused by railway locomotives. Fires occurring from any other causes can be pretty effectually prevented by stringent laws and effective enforcement by the Province, but Dominion railways must be dealt with by Federal legislation. The laws of Canada relating to fires caused by railway engines certainly require amendment. Upon what principle do we permit railways to spread abroad destruction of public and private property? The time may have been when the necessities of transportation and the comparative poverty of the railway companies made it impracticable to enforce stringent laws, but that time has surely passed, and I have no doubt the great companies will themselves readily realize their duty in this respect.

This question of prevention of fires arising from railways is a very large and difficult subject, but we must be prepared to face large and difficult subjects if we desire to accomplish important results. Throughout the whole of the district which I have mentioned the land immediately adjoining the railway track is covered with inflammable material, which, in dry weather, will generate fire from the smallest spark. As conditions exist, frequent fires are inevitable. The condition is one for which a remedy ought to be insisted upon.

With proper protection from railway fires, the Government of Ontario could make a reserve of the whole district, and place it in charge of a warden and staff who would protect it from fire at a comparatively slight cost, and arrest the course of destruction which is going on. Given the slightest chance, the land will reforest itself. Even now there are extensive growths of young trees along the railway line, but unfortunately, under existing conditions, they are doomed to destruction. Planting might be easily and economically carried on to a considerable extent, but, without that, throughout the greater extent of the territory, reforestation will be effected by nature.

Here is the greatest opportunity that any Government ever had to conduct an extensive operation in forestry—at trifling expense and with certainty of valuable returns. The territory would be a mine of wealth.

Railway ties are every year becoming more scarce and difficult to obtain. I am told they are now worth from fifty to sixty cents per tie. Great quantities of ties are required now and the demand is steadily growing. In the United States, an important railway company has actually bought land and commenced to plant trees in order to supply ties for the future. The cut-over and burned-over Crown lands of Ontario and Quebec would, in time to come, if properly

protected and fostered, supply ties for the whole of Canada from the New Brunswick line to Regina, and the Governments of these provinces would draw revenues from them which would be counted in millions.

The trouble with us in Canada is that our country is so great we are apt to overlook its possibilities. Especially are we prone to neglect what does not produce present results. It is no doubt true that present and pressing problems demand incessant attention. Nevertheless, we must look also to the future. The man who takes up this subject, grapples with it and fights it to a successful conclusion will write his name very clearly and distinctly in the history of the country.

Then there is the great northern region of Quebec and Ontario, and that portion of New Brunswick through which the National Transcontinental railway is being constructed. The House of Commons' Committee on Forests and Waterways made a partial investigation into the question of prevention of fires in these districts at the last session of Parliament, the record of which will be available as a basis for further work. It appears that the Transcontinental Commissioners have been giving attention to the subject in conjunction with the Provincial Governments, with, so far as is known, fairly satisfactory results. I understand also that the Government of Quebec has recently had the matter under serious consideration. The investigation to which I referred was necessarily somewhat cursory, and the matter should be systematically and thoroughly gone into in order to make it absolutely certain that the same unfortunate results which have followed railway building in other forest districts will not follow there also.

In referring to this matter I speak with perfect frankness. As between Governments and political parties and public men, if there has been neglect we have all been to blame. What is required now is direct and cordial co-operation between Dominion and Provincial authorities.

Lands—Agriculture is the foundation of all real and enduring progress on the part of Canada. It is one of the striking facts of the present social condition in the United States and in Canada that, with a few exceptions, those men who, by reason of strength of character and intellectual pre-eminence, take the lead in public affairs, in professional life and in scholarship are, as a rule, removed not more than one or, at most, two generations from ancestors who tilled the soil.

The possession of a preponderating rural population having the virtues and strength of character bred only among those who follow agricultural life, is the only sure guarantee of our national future. The possession of such a population depends upon the maintenance of the fertility of the soil.

The idea that such fertility will endure without the most anxious and strenuous care is contradicted by the well-known facts of history. The countries from which Xerxes led his hosts to the attack of Greece were highly populous. Persia, Babylonia, Palestine and surrounding countries were the homes of dense populations of many millions, and all our information about them leads to the conclusion that the inhabitants lived in a high degree of comfort. To-day these countries are comparative deserts. Egypt, the ancient store-house of the world, became largely barren, and remained so for centuries, with its rural population sunk in wretchedness and poverty, until British engineering skill and administrative ability gave it a new lease of life. Spain, under the Saracens, is declared by high authority to have been more highly developed agriculturally than any country of modern Europe up to twenty-five years ago. Peru and Mexico were agriculturally in a better condition, with more enlightened laws relating to agriculture before the days of Pizarro and Cortez, than they are now, though Mexico, under the present administration, is making wonderful progress.

Coming closer home, there are thousands of farms in the New England States which are practically abandoned through depleted fertility of soil.

We have no great reason to be proud of our treatment of the soil in modern countries. We have never approached the economic wisdom of the biblical law which governed the Jews in their treatment of the land. Not long since I read that, in the time of the Incas, the breeding of the birds which produced guano, off the coast of South America, was strictly protected by law, while modern civilization has permitted the supply of this most valuable fertilizer to be seriously diminished by ruthless exploitation.

On the whole, the most successful efforts to preserve the fertility of their soils under the pressure of a great population have been made by China and Japan, countries which we are disposed to think can teach us nothing, but have everything to learn from us. As a matter of fact, China and Japan alone go the whole possible length in avoiding the waste of fertilizers and restoring to the soil everything that is taken from it. Speaking generally, and leaving Japan out of consideration, in the words of a recent authority, "wherever in this world "there is a large population dependent for its livelihood upon soil which has "been cultivated for upwards of two centuries, there is extreme and depressing "poverty."

We are, in the practice of our best agriculturists, more fully abreast of the most advanced nations in agriculture than we are in the treatment of any other branch of natural resources, but our advanced agriculturists are far too few in number. The development of scientific agriculture is now being promoted among us by a large number of institutions supported by public and private funds. Experimental farms and agricultural colleges are rendering services of the highest value. The applicatiaon of agricultural chemistry affords a vast field for constructive effort. In connection with these institutions such men as Dr. J. W. Robertson and Dr. W. Saunders, Director of Experimental Farms, have done a work the importance of which it is impossible to over-estimate.

Is there, therefore, nothing for us to do in this department? On the contrary, speak for a few minutes with any minister administering such institutions, and, if his heart is in his work, he will tell you that there are whole fields of labour, of valuable research and investigation, which he is unable to attack for lack of men and means.

We are fortunate in having among our membership men eminently qualified to direct our deliberations upon this subject, and under their advice it will, no doubt, be possible to do much valuable work.

Let me conclude by calling your attention to the unique position occupied by Canada at the present period of its history. For many years, the progress of the country was comparatively slow. A combination of circumstances was responsible for that fact. Sparse population, great natural obstacles to transportation, peculiarities of geography, our proximity to the more wealthy and attractive United States—all combined to retard progress. It has taken the toil of generations to attain the present position. Now our time has come. Population is flowing in; development of resources is proceeding rapidly; trade is growing. In all human probability a period of great expansion and prolonged prosperity lies before us.

It is as certain as that day follows night, that this condition will bring a large influx of capital, particularly from the country to the south. This capital will come with the object of acquiring whatever revenue-producing assets Canada possesses. It will not come for philanthropic purposes. It will come to acquire and to monopolize. It will come with a volume and a power that no single individual or corporation can resist. I could, if I chose, give you some very striking illustrations of how this movement has already begun, but that is not necessary. It does not take a very profound observer to see that, within ten

years, United States capital will be on the spot to acquire nearly every one of our great natural resources of wealth, except our farm lands and fisheries, which in the nature of things, cannot be monopolized, though they may be heavily tolled by monopolists.

If, then, we are desirous that Canada shall remain Canadian, a good place for Canadians to live in, and a good place for our children to make their homes, it is in the highest degree important that we should endeavour to promote such improvements in the organic laws of the country as will prevent the monopolization of the sources of wealth, and, at least, ensure to the people their full share of the wealth which is produced therefrom. We have the experience of other countries to draw from, and it will be our own fault if we do not profit by it.

This Commission can exert a powerful influence in the right direction. It can strengthen the hands of all who are desirous of following progressive policies. It can help to render the labour of investigations in the various branches of scientific thought available for the service of the country. It can be the vehicle by which enlightened and educated men can bring an influence directly to bear on the administration of affairs. In a word, it can, if it will, be the embodiment of public spirit and advanced thought.

After concluding his inaugural address, Mr. Sifton said:—

We are fortunate in having with us to-day, as an indication of his interest in the important subject which is before us, the representative of His Gracious Majesty, His Excellency, the Governor-General. I may say it is a source of great satisfaction to us to know that a gentleman in his exalted position takes a deep and intelligent interest in work of the kind which is coming before this Commission. I am sure you will be delighted to have a few words from His Excellency, if it will please him to address you.

EARL GREY'S ADDRESS.

Mr. Sifton and Gentlemen:—

It is hardly necessary for me to assure you that I am not going to inflict on you anything like a dissertation on the natural resources of Canada or how to develop and conserve them. I have come here in a spirit of sympathy with this movement, and with the desire to learn something of your plans. Perhaps the most illuminating remark in the patriotic and able address, so replete with important and interesting facts, to which we have just listened from Mr. Sifton, was his confession that he was determined to divest himself of his party coat in order that he might put up a shirt-sleeve and effective fight in the interests of conservation. The constitutional limitations of my office prevent me from divesting myself of my gubernatorial robes; but, so far as I may be permitted, I will give you and the Conservation Commission every assistance in my power to enable you to fulfil the objects of your work.

I do not think anyone who has listened to this illuminating address, or anyone who may read it—and I hope it may be reported verbatim in the public journals—will fail to realize that the future well-being of Canada depends on the loyal acceptance by its people of the principles which aim at the profitable and scientific development and conservation of your natural resources. I recognize that the future prosperity of Canada depends on scientific research and upon the efficient application of the results of that research to the industrial and physical life of the people. The character of this assembly, recruited from every part of Canada, shows that this Conservation Commission will help in consolidating the Dominion; and it appears to me that another important advantage which will result from this movement is that the teaching of conservation undoubtedly carries with it a lesson, viz., that the interests of the individual must be subordinated to the greater interests of the State, and that any practice, however advantageous it may be to the individual concerned, which mili-

tates in any way against the greater interest of the State, is a practice which cannot possibly be indulged in by any but an absolutely selfish man.

I have come here, Mr. Sifton, to listen to your address, to show the sympathy which I feel with the Conservation movement which you are leading and to show that I think the object of this movement is one which aims at the promotion of the national welfare and the development of individual duty.

The Commission then adjourned.

WEDNESDAY MORNING.

The Commission met on the morning of Wednesday, January 19, at 10 o'clock, in the Carnegie Library. At the opening of the proceedings the Chairman of the Commission called to the chair Hon. Frank Cochrane, Minister of Lands, Forests and Mines in the Ontario Government, who presided during the morning sitting.

Hon. Mr. Cochrane: I appreciate the honour done me in asking me to take the chair. The gentlemen forming this Commission have met here not only in the interests of the Provinces—one of which I represent—but in the interests of this great Dominion. There is, in my opinion, no question before Canadians to-day of greater importance than that of the conservation of our natural resources. I congratulate the Honourable Mr. Sifton on the able address he delivered yesterday and the foundation which he laid in it for matters for our consideration. When the Commission gets down to business I trust that one of the first things done will be to order the printing of that very able address of the Honourable Mr. Sifton, so that it may be circulated broadcast throughout the Dominion. I believe that a perusal of that address will set the people of Canada thinking about the magnificent natural resources which Providence has bestowed on their country, and the all-important necessity of conserving them for us of to-day and for our descendants. As the business of to-day is somewhat technical, I shall not prolong my remarks.

Hon. Mr. Cochrane then called upon Dr. B. E. Fernow, Dean of the Faculty of Forestry, University of Toronto, who read a paper on

SCIENTIFIC FORESTRY IN EUROPE: ITS VALUE AND APPLICABILITY N CANADA.

Dr. Fernow said:—

At the invitation of your Chairman, I am to bring before you information as to what has been accomplished by scientific forestry in other countries and to indicate how far similar methods may be applicable in Canada.

The first part of my task, being a matter of description, is simple enough. I need only condense what I have enlarged upon in two volumes which I have compiled. The second part, however, being a matter of judgment, would require a rather more comprehensive analysis of Canadian conditions than the brief time at my disposal would permit. It would, moreover, in part, anticipate the work of this Commission, and it can, therefore, be treated by me only suggestively.

Perhaps your Chairman, in formulating the first query, did not, when using the term "scientific," realize that this, to a technical man, suggests the application of technical knowledge to secure practical results; that, at first sight, it

limits the enquiry to the result of methods of silviculture and technical forest management. It differs from the application of scientific politics—the statesman's inauguration of policies—to the treatment of forest resources. Nevertheless, to the discussion of this I shall also, in a later part of my address, devote a few minutes.

The first, and more limited, question of technical results from scientific treatment is quickly answered. The result of scientific treatment, i.e., as compared with letting unsystematic exploitation and nature take their course, must lie in the production of larger and more valuable forest products per acre in a shorter time. That this result has been achieved wherever scientific procedure has been followed, can be proved by figures. It must, however, be realized that the results always come only in the long run, for forests grow slowly, much more slowly than is usually realized. Prussian state forests—not by any means the best or even best managed in Germany—in 1830, when systematic management had been applied for only a short time, produced only 29 cubic feet per acre per year, of which less than 20%, or under 6 cubic feet, was of log size fit for the arts. By 1907, thanks to the forester's art, the product had increased to 61 cubic feet per acre per year, 52 cubic feet of which was over 3 inches diameter, and the percentage of saw timber had inreased to 63 per cent., or 33 cubic feet per acre per year. The forester, then, had succeeded in making, not two, but three to five blades grow where one grew before. Or, if you translate this material result into financial form, you will find that the gross revenue per acre of 72 cents and the net revenue of 44 cents in 1830, had grown, in 1907, to $4.55 for gross and $2.52 for net revenue. That is to say, there was an improvement in the net result annually, of 2¼ per cent. compounded, while the principal—the forest—was continuously improving and becoming more efficient.

It is to be understood that these results came from annual growth, the wood capital on which they accumulated remaining untouched, so that this, or a better cut, can go on forever.

In this financial result, the increases in price of stumpage play, of course, a part, but, since wood prices during the period have hardly trebled while the income, as we have seen, has more than quintupled, the forester's art claims almost as much credit for the result as the economic changes which influenced the price.

While this is the outcome of a large and somewhat extensively managed property of 7 million acres, which still entails much dead work for improvement, and hence promises a still better revenue for the future, the smaller State properties of Saxony and Württemberg show still more striking rewards—rewards which are, indeed, two or three times as high. In Saxony, with somewhat less than half a million acres of state forest, mostly spruce, but most intensively managed, the cut increased from 60 cubic feet per acre in 1817-26, to 94 cubic feet in 1905. The timber-wood increased from 17% to 66%, or 62 cubic feet per acre; the gross revenue from $1.57 to $8.00, and the expenditures from 95 cents to over $5.00.

That still further improvement is possible, is shown in the last four years, for, in 1909, the cut of timber-wood had still further increased to over 78 cubic feet, which comes near the maximum attainable. The gross income was over $9.00, and the net revenue $6.00. Saxony, in 50 years, had taken some $200,000,000 from her small forest property without impairing its producing value.

In the same year, Württemberg, with 90 cubic feet per acre, and a net yield of $740, probably reached the top notch, at least of material production, for a large and varied forest property. Altogether, the forests of Germany, 35 million acres, produce around 1,700 million cubic feet of wood in annual growth, of which about 41% is saw material, or 20 cubic feet per acre (about 150 feet B.M.).

Comparing this with the 33 cubic feet stated for Prussia, we are at once confronted with the important fact that State forests, which represent only one-third of the forest area, produce not only a larger amount of growth per acre than do private forests, viz., over 50 per cent. more, but they also produce the better class of wood in larger proportion, that is to say, nearly 20 per cent. more. The State-controlled forests take an intermediary position. In other words, Prussia from an acreage which is about one-half the area now under license in Ontario, derives annually at least seven times the net income of Ontario, and that not, as does Ontario, by depleting its capital, but by merely taking the interest of the annual growth. Moreover, the interest is increasing now at a rapid rate, while the capital also is continually enhancing in value.

It might be suggested that the difference lies in the difference of stumpage values. While this is true in part, it is not the whole difference, for the average stumpage value in Prussia is now less than $10, and the highest price for pine is in the neighborhood of $18, which is hardly more than double the stumpage rate in Ontario.

There is, then, no doubt that the difference lies largely in the manner of management. I should add that the results in Prussia by no means represent the final possibilities. There are still many areas in her State forests which are not yet in full productive condition; there are waste areas still awaiting planting; there are other areas still inaccessible to markets; and there is no reason why the saw timber percentage should not reach that of Saxony, namely 80%.

To cite one more case of financial result of forest management, I may refer to waste land planting in France, which was carried on with State aid, by municipalities and private enterprise. Here, in the last 60 years, 2,300,000 acres of absolute waste land of various descriptions were reclaimed by forest planting at a total cost of $15,000,000. These areas are now estimated to be worth $135,000,000 and furnish annual crops valued at $10,000,000, or, in other words, yield 67% on the initial outlay. These examples of the profitableness of practical or, if you will, scientific forestry can be multiplied indefinitely wherever it has been carried on long enough.

What does this scientific treatment that leads to such results consist in? First of all, in a difference of attitude, namely, in considering timber as a crop capable of reproduction, and not looking on the forest as a mine which is bound to be exhausted. Instead of allowing a lumberman to cut down and carry off all that is good and marketable, and leave the poorer materials and the slash to burn, or permitting a reproduction of the good, bad and indifferent species which nature unaided might chance to establish, the forester first of all ascertains in detail the character and composition of the forest property. He then makes a plan—a working plan—in which it is determined how much of a felling budget may be taken properly and yet assure continuous crops. He then proceeds to cut with a view to securing the new crop, first improving the composition by removing or killing the weed trees to give a better chance for the valuable species, and then cutting the old crop gradually, as the young crop needs more light. Or else, he may clear the entire stand and replant the area, a method under which 65% of the Prussian forests is managed. There are a number of other methods, each adapted to given conditions. The one difference between forester and lumberman—and the only one—is the obligation on the part of the former to provide for the future, to leave a forest crop in place of the harvested one.

Unfortunately, this crop takes a long time to mature. Only he who can afford to work and wait for the distant reward can engage in and find profitable, the management of timber lands for continuous revenue, at least from saw timber. Only the State or other persistent corporations can do this. If history teaches anything, this is the lesson taught by European experience.

How did the countries which apply such treatment to their forest resources come at it? How did forestry originate? Precisely as any other industrial art comes into man's life—by the necessity or desirability of it appearing. There are three reasons for the practice of the art of perpetuating forests. The most obvious is to secure continuous wood supplies; another, mainly of local import, comes from the fact that the forest cover influences soil and water conditions, and the third, a reason of sound political economy, is that areas unfit for farm uses may still be made productive by forest cropping.

Although, in Germany, sporadic attempts at forest cropping date back to the 14th and 15th centuries, systematic forest management did not become general until the end of the 18th century when a timber famine was actually threatening certain portions of Germany. The fact that, at that time, wood was the only fuel, that rivers were practically the only means of transportation, and that the dense population in the river valleys had used up near-by forest supplies and turned the lands into farms, while the extensive forests of mountain and hinterland were largely inaccessible, will explain the existence of this timber famine. At that time, German forests were largely in the condition in which we now find much of our Canadian forests—largely culled, slashed, burned or inaccessible. For instance, in 1778, it was reported from eastern Prussia that "not a single acre could be found in the province that had not been burnt in earlier or later times," and that "the people are still so much accustomed to the ruthless use of fires that no punishments could stop them."

All the nostrums which are now advocated in Canada, and more particularly in the United States, to relieve the situation, were recommended then, and, in part, practised. These included the planting of rapidly growing trees, the fixing of diameter limits below which trees might not be cut, marking the trees which might be felled, even on private property, and other interferences with private rights. Restrictions in the use of wood for buildings, coffins and other manufactures; in the use of Christmas trees and in the use of fences, were instituted. Even the number of buildings for any community was under regulation. The wood trade generally was regulated by laws. Finally, however, the forester, by using common sense and scientific knowledge, and especially by properly using the commonplace natural conditions at hand, showed the way out.

It is not my purpose to trace the history of development of modern forest policy in Europe, but I wish merely to point out that we may learn from that history as well what to avoid, as what to do, to meet similar conditions.

During the 19th century, one European nation after another came to recognize the necessity of substituting management of its forest resources for ruthless exploitation. The governments conceived it as their duty, in the exercise of their providential functions, to provide for the future. The last to fall in line—and they are still uncertain and undeveloped in their forest policies—were naturally the countries exporting forest products, Russia and Sweden; and, now, the United States and Canada—the countries which erroneously suppose themselves to have a surplus of forest resources to dispose of—are joining the ranks.

While local considerations, such as the prevention of soil erosion, of torrents and floods, of sand drifting and the necessity of using waste lands, have led to measures of reforesting, the main and universal incentive to the practice of scientific forestry is the necessity of obtaining wood supplies.

To discuss this question at length would lead us too far. Indeed, it should be understood that accurate statistics, and, in many cases, even reasonable approximations to conditions, are lacking. Hence only very general statements are possible. All data available, however, show that, at the present time, all countries, except the southern ones, cut more than the actual annual growth of

their forest area, that they are cutting into capital, and are within measurable time of the exhaustion of their supplies of timber of serviceable size.

The value of the forest areas of the southern hemisphere, largely located in the tropics, is in doubt, since they produce woods which, under present methods of use, have but limited application. While the wooded area of the world may be figured at over four billion acres, the really productive forest area capable of furnishing the kind of timber which plays a rôle in the markets of the world is probably not over half that figure. The annual consumption of wood is tolerably closely known to be in the neighbourhood of forty billion cubic feet; and this, besides supplying home consumption, gives rise to an export trade of $300,000,000. If we were to take 40 cubic feet as a fair average production per acre —in Sweden it is figured at 25, in Germany at nearly 50 cubic feet—it would appear that a large enough area is on hand to furnish all supplies, provided it were managed for such production. And it is such management that we, in this Commission, are called upon to bring about.

All the varied methods which have been applied to secure an economic and scientific handling of forest properties for reproduction can be briefly classified under four heads:

1. Government ownership and management, based on the *paternal* function of government.

2. Municipal ownership and government supervision of its management by exercise of the *fiscal* function of the State.

3. Regulation of private forest management by exercise of the *police* function of the State.

4. Encouragement of private forest management by exercise of the *educational* function.

State ownership and management, which, at the end of the 18th century, under Adam Smith's teaching, had been discredited, is now considered the most efficient means of securing results. Nowhere else are public ownership and administration for the public interest so essential and indispensable as in the case of forests.

The conclusive arguments for State ownership are, that the long time element involved in forest cropping—60 to 120 years—is discouraging to private enterprise, and that the protective function of a forest cover on mountains and in other locations, which requires ultra-conservative use, imposes the duty on the State of maintaining proper forest conditions.

Practically every European state, therefore, owns forest property, and, during the last thirty to forty years, the tendency is, at least in some countries, notably Germany, to enlarge it by taking over mismanaged private forests, buying and reforesting waste areas, and exchanging farm lands for forest. Prussia, for instance, in 1902, not only provided for a naval programme which now has suddenly aroused attention, but set aside some $30,000,000 for purchase of waste lands: and in addition, she annually spends nearly half a million dollars in reforesting these. During the last forty years she has increased her forest property by nearly 13 per cent. Yet the actual ownership of forest by the governments of the different German States does not exceed 33 per cent. of the total forest areas, as against 62 per cent. in European Russia, and over 35 per cent. in Sweden.

These State properties are managed under well organized forest departments, the administration performing all the forest work down to the cutting of the wood, selling logs and cordwood, etc., in the forest, or else, as is frequently done in France and Russia, selling the year's cut on the stump and carefully supervising the cutting.

Municipal ownership is especially well developed in France, where 23 per cent. of the total forest area is under municipal auhority. In Germany only 15 per cent. is municipally owned. The management of these municipal forests, which are, in many cases, most valuable sources of income for city or town, is closely controlled by the governments in various ways, e.g., by requiring professional foresters to be placed in charge, by having working plans submitted for sanction, by giving expert advice, and, in some cases, as in Baden, by the Government managing them directly for an annual charge per acre. Altogether, this supervision is of a fiscal character to prevent the dissipation of municipal property, and is based on the same principle as that by which we limit the debt which a municipal corporation may incur.

Private property, which, in Germany, represents one-half of the forest area, is much less controlled by Government than is usually supposed. Yet about one-half is in some manner or degree controlled, so that only 25 per cent. of the entire forest area is without any control whatever, and this portion is easily distinguished by its poor condition.

The State supervision over private property is of two kinds. Entailed properties are looked after, like municipal properties, under a family compact with the Government, by which the Government is obliged to prevent dissipation of the property. In the southern and southwestern states, which are mountainous, the control is of a police character, for the purpose of preventing improvident clearing, which might lead to soil washing, torrential action, etc. Otherwise, there is not much control, and, in Prussia, and some other parts, it is entirely absent. Restrictive measures on private properties have always been found difficult to enforce, and, therefore, undesirable. Such paternalistic propositions as are now agitated for in the United States, e.g., restricting private owners generally from cutting below a certain diameter limit, would be considered childish and intolerable.

In France, the supervision of private forest management is much more developed than in Germany, and is much more strict. On the other hand, ameliorative or persuasive measures have been, especially lately, highly developed in Germany. The formation of forest planting associations to reclaim waste lands, or to manage small forest properties to better advantage by merging them and then employing professional foresters, is encouraged. Plant material is given to would-be-planters, with advice, which is furnished, rarely free of charge, but yet at a low cost. Bureaus of information, with experts who act at a low charge, are established in each province in Prussia, and are developing remarkable activity in assisting forest owners to secure better results in forest and market. The large number of well-trained foresters of higher degree makes it possible to extend better technical procedure in all directions, the governments merely facilitating the way to its employment.

There are no fakes and nostrums of paternalism employed, but everything is conducted on business principles, such as should commend themselves to any democratic community. The Government simply uses its better facilities and greater credit to help the citizens to help themselves and the community.

Of course, there are forest schools, mostly supported by governments, some eight higher schools to educate the eventual forest managers, and some eight or ten to educate the lower forest officers. The experiment stations are instituted to put practical forest management, which is relying still, to a large extent, on mere experience and empiricism, upon a more scientific basis. Such, then, are the scientific results of good forest politics.

I have confined myself largely to conditions in Germany, partly because I am personally more conversant with them, partly because here are exemplified all the different methods and policies that have been and are being used elsewhere, or have been tried and found wanting. For direct application to Can-

adian conditions this German development is, to be sure, too ideal, too far advanced, too intensive, and we should, perhaps, look at some country which is more nearly comparable to ours in its present condition of development, for points which we might utilize immediately. It is, however, my belief that all progress would be more rational if it were directed by the ideals that have shown practical value.

The country which most nearly resembles our own, both in physical character, forest conditions and methods of forest administration, is Sweden.

Sweden, with fifty million acres of forest on 50 per cent. of its land area, has been, and is still, one of the largest, if not the largest, exporters of forest products, mostly spruce and pine. For the last 20 years forest products contributed between thirty and forty and, including wood manufactures, over fifty million dollars' worth annually to the export trade. Every year the cut per acre has increased, until now it may be a thousand million cubic feet. The realization that this important resource is being rapidly diminished has come, as with us, only within the last decade.

Hardly 10 per cent. of the country is cultivated, the rest is barren or wooded, at least 40 per cent. of which is State owned or partially controlled by the Government. Forest fires and the axe, as with us, have devastated and deteriorated large areas, especially in the northern zone, where the growth is as slow as with us (one inch of diameter in 12 to 15 years). Similar policies as with us have prevailed. To attract settlers, crown lands were given away freely, the settler selling the wood to lumbermen, while a loosely conducted license system handed the forest property over to the lumbermen. Licenses to cut timber limits were given on long terms (50 years; later, only for 20 years) for prices which were often realized from the forest in the first winter. A diameter limit of 12 inches, measured at 18 to 20 feet above ground, was usually the basis of the lease; but the licensee could somehow lease away smaller sizes, so that several persons secured rights in the same forest. In the absence of a sufficient force of forest guards, supervision was slack and wasteful practices abounded. Owners of iron works had the right to secure their wood supplies, charcoal, etc., from the State forests, but if, for any reason, the iron works were abandoned, the forest privileges were continued; the iron men turned lumbermen, or even sold the properties as if they were their own. This went on until, in 1896, the Government began to challenge titles and institute legal proceedings to recover its own. As a result, many were forced to secure the fee simple, and some thirty million acres of forest, or, including unreclaimable waste lands, over fifty million acres, became private property. Meanwhile the State, by purchase and reclamation of waste lands, still further increased its holdings.

Although sporadic attempts to control the exploitation to some extent date back centuries, and a commission of German forest experts was called in as long ago as 1760, while during the 19th century repeated attempts were made to create a saner forest administration, private interests were strong enough to render them nugatory. But, in 1903, as a result of a painstaking extended canvass by a legislative committee, a law was enacted which was to go into effect in 1905, placing the control of all private forest in the hands of Forest Conservation Boards. These Boards, one for each province, have surveillance of all private forests, the owners being obliged to submit felling plans to the committee for approval. The Board may also enforce reforestation of cut-over areas, may forbid clearing, and may order the adoption of specific measures of conservation; for the law itself refrains from formulating any rules.

These Boards consist of three persons appointed for three years, one by the Government, one by the County Council, and one by the managing committee of the County Agricultural Society. In addition, where the communities desire, elected forest commissioners may be added to the Board. The Board can enforce

its rulings by court proceedings in which injunctions to prevent further lumbering, confiscation of logs or of lumber, or money fines, etc., may be adjudged.

An export duty of 4 to 8 cents per cubic foot on timber, and 8 to 14 cents per ton on dry wood-pulp is imposed to furnish funds for carrying out the law. A more systematic administration of the State forests, under the Domain Bureau of the Department of Agriculture, was also provided, and the time limit for timber licenses reduced to five years. The management of municipal forest properties is placed under the State administration, the corporation paying for such service.

To be sure, the forest management of the State, as well as of private owners, can still be only extensive, and the methods of lumbering—usually the stumpage being sold—resembles ours, while forest fires are still not infrequent. But there is supervision by professionally educated foresters, and, to judge from the publications of the Association of Foresters and of the forest experiment stations, remarkable progress has lately been made. I would advise that the character and actual practical working of these attempts in Sweden be submitted to a closer inspection by this Commission.

I shall now add a few suggestions respecting the applicability in Canada of policies which elsewhere have proved advantageous.

The first objection which so-called practical men urge against adopting policies or methods practised elsewhere is that our economic and political conditions are so different as to preclude such adoption. This is, of course, true, and only a visionary would think of transplanting bodily a system which has no natural affinity to its new surroundings. Nevertheless, the principles underlying that system may be recognized as desirable, and a knowledge of the experience had in applying these principles to a given system may assist the judgment in altering it to suit the conditions as they exist, and, before any change in the present methods of waste and destruction can take place, the causes of such waste must be analyzed to see how, and to what extent, they can be removed.

The first and greatest need is, however, a change, a radical change, in the attitude of our people and governments from that of exploiters to that of managers. We should realize that existing methods of treating timber lands are bad, and that a change is imperatively needed. Only when there is doubt implanted as to the propriety of our present methods of forest management, and only when people realize the urgent need of change, will the radical reform be inaugurated that we believe necessary. When that attitude is established which demands that our forests shall be managed, not merely exploited, all the rest will be comparatively easy, and it will then astonish the practical men to find how much European methods and systems are really applicable, just as it lately surprised the Americans across the line.

To secure the change of attitude, more knowledge is needed. Just as the Swedes based their recent legislation upon a more or less careful ascertainment of their forest conditions, so should we endeavour to ascertain more precisely where we stand. Our knowledge as regards our forest resources is, at present, to a great extent, guesswork. While it would be too expensive to make actual forest surveys of the whole country, yet a more authoritative collation of known facts, presented in such a way as to suggest the needs of future methods of treatment, is possible and desirable. Such a forest survey as I conducted for the province of Nova Scotia last summer at a cost of less than 25 cents a square mile would be more than sufficiently accurate for the purpose. Here are the results of that survey:—

Mapped 7,400 square miles = 4,700,000 acres: twenty per cent. in farms or capable of farm use; some 21,000 acres of natural meadow; 24,000 acres open bogs, capable of utilization; some 2½ million acres, or 53%, of forest land, of which (1) only 75,000 remains virgin, or nearly so, (2) 445,000 lightly culled,

(3) 1,115,000 severely culled, (4) 130,000 young thrifty growth, besides 34,000 second growth pine ready for cutting, and 280,000 acres, or a little over 1%, recently burned; 25%, or 480,000 acres of old burns, and 690,000 acres of barren land, which could be made partially useful; 2%, or 90,000 acres unknown.

State ownership of the bulk of the forest property being the actual condition in most parts of the Dominion, it should be comparatively easy to change from the present methods of administering it to better ones. The experience of other nations, that State ownership has invariably furnished better results than private management, either without or with State control, should make us adhere to State ownership as a principle. If this is agreed to, then the installation of properly manned and properly endowed forestry bureaus in each province to manage this property on forestry principles, following the example of the Dominion Government, should be the next step. Perhaps, however, before such bureaus are established, it might be advisable to appoint Royal Commissions for each Province, or possibly, Committees of this Commission, as the Chairman has suggested, similar to the Swedish Forest Conservation Boards, to formulate plans of procedure. This would very acceptably remove the reform from the political arena. For one thing, it can be proved beyond doubt that the existing license systems are the greatest hindrance to reform, and the most difficult task would be to adjust equitably the rights of licensees and yet secure this change, without which no hope for the future can be entertained.

Each province and sections in each province vary to such an extent, when it comes to application of technical methods, that each bureau must be left to work out by itself the proper way of handling its problems. That is to say, legislation, even provincial legislation, should be as little specific as possible, leaving to the administration the formulation of rules, just as is done in European countries. Such a thing, for instance, as a general diameter limit to which cutting may be allowed, is a mistake.

Every method to cope with forest fires which is used elsewhere is applicable somewhere in Canada, and none should be left untried. Every silvicultural practice used in Germany or Sweden is practicable in Canada somewhere, with proper judgment. The only reason that should keep it out is expense. But even this reason is only apparent, and very temporary. We know, for instance, that white pine stumpage in this country has now reached the figure which will cover the cost at which it can certainly be reproduced by artificial planting and return at least 4% compound interest; and soon other species will have reached the stumpage price which represents cost of production. To be sure, the results are realized only in the long run, and, hence, only the Government or municipalities are fit to engage in such ventures, which must, however, in time, turn out as profitable as the undertakings of Germany or France. Every method employed in the old countries to encourage private forestry, especially by education, expert advice and other assistance, is applicable now in Canada, except, perhaps, for the lack of experienced personnel. Only the restrictive measures on the exercise of private property rights need to be carefully scrutinized. And these, we have seen, are largely of historical development and not favoured in their own country when other methods are possible. While we may have to vary the precise method by which we attain results, it is my belief that every principle which has been found to work elsewhere can be put in practice in Canada, and can be practically applied now, if we so desire.

It may be useful to summarize the six essential points made in this statement:—

1. Wherever forestry, i. e., managing timber lands as a crop, has been practised for long enough time, its results have shown themselves in increased production per acre and in greatly increased revenues.

2. Every principle involved in the successful systems inaugurated in other countries can, with proper judgment, be applied somewhere in Canada, even now.

3. To secure such application of improved methods in handling timberlands, first of all a change of attitude towards the forest on the part of the Governments and people is necessary, namely, from considering it as a mine to be exploited, to conserving it as a crop which can be perpetuated by management.

4. Such change of attitude may be secured by more definite and reliable information regarding our timber supplies, and the need or desirability of their conservative use—information which it should be the first business of this Commission to collate.

5. The timber license systems are inimical to the radical reform which is believed necessary in order to secure such conservative use. Hence, comprehensive plans for an equitable adjustment of the rights of licensees, which will, however, restore the full control of the properties to the provincial Governments, need to be formulated.

6. This can best be done by Royal Commissions or Special Forestry Committees for each province, unhampered by political considerations, and leading eventually to the creation of special bureaus for the organization of a forest service.

HON. MR. COCHRANE—The information given in this paper by Dr. Fernow is most interesting, and although his suggestions are pretty radical, yet I think a great many of them might be put into effect without doing injury to the individual.

I regret to say that Hon. Mr. Allard had to return to Quebec last night on account of illness in his family, and so will be unable to address us. I call upon Dr. James W. Robertson, who will address us upon

THE CONSERVATION OF AGRICULTURAL RESOURCES

Dr. Robertson said:

May I offer one word of explanation before I speak on this large subject? I have been separated from my office—from my books and papers—since I was asked to prepare this address; consequently, it will not be so compact nor so full as I would like it to be for an occasion like this. I am sure your indulgence will be generous under these circumstances.

On Friday of last week, just five days ago, the President of the United States sent a special message to Congress, on "Conservation of the Natural Resources of the Nation," and, since the movement for conservation in the two countries has been not only concurrent, but cordial, and has been going forward with harmonious co-operation, I may be permitted to begin by quoting one passage from the message of President Taft.

"In considering the conservation of the natural resources of the country, the feature that transcends all others, including woods, waters, minerals, is the soil of the country. It is incumbent upon the government to foster by all available means the resources of the country that produce the food of the people. To this end the conservation of the soils of the country should be cared for with all means at the government's disposal. Their productive powers should have the attention of our scientists that we may conserve the new soils, improve the old soils, drain wet soils, ditch swamp soils, levee river overflow soils, grow trees on thin soils, pasture hillside soils, rotate crops on all soils, discover methods for cropping dry-land soils, find grasses and legumes for all

soils, feed grains and mill feeds on the farms where they originate that the soils from which they come may be enriched.

"A work of the utmost importance to inform and instruct the public on this chief branch of the conservation of our resources is being carried on successfully in the Department of Agriculture."

That presentation of the question may be taken as appropriate to Canada also. The recognition by President Taft of the valuable work of the Department of Agriculture in his country may be applied with equal aptness and pride to Canada by anyone who knows what the Dominion and the Provincial Departments of Agriculture have done and are doing.

The agricultural resources of Canada may be regarded as the chief asset in the landed estate of the people of the Dominion. A vast heritage has come to us from our ancestors, who won it by labour, courage, and privations, careless of personal ease that their children might have a good start, a good chance and good homes. The main thought was for us and their country, and all that stands for in its broadest interpretation and its widest application. We have entered upon the unearned ownership of what they acquired and what they achieved. Why did they come to Canada? (I speak with some knowledge, at least regarding one family, because I was present at the family counsels and discussions). They came because this was a land of liberty for individuals; and I think none of us need fear that this Commission will encroach upon that. They came because it was a land of respected law; and, if we help to secure better laws adapted to our new conditions, then so much more insistent and powerful will the call be to all of us to preserve our right to that reputation. I happen to one of the many who have found it to be a good land in that sense. Why did those born in this country toil for its development? For similar reasons, and chiefly that it might be a good place for homes when the children came to their inheritance.

While this Commission is not charged with the conservation of all these priceless possessions, it may be expected not to contravene these birth-rights, but to help in extending their enjoyment through the wise use of what we have in the several departments of the nation's property. Our landed estate is not fully known to any one mind, but we have many minds capable of grasping something of its real significance and possibilities. There is nothing on record yet with anything like fullness as to what we have, what we are doing with it, or what we may do with it. Our youth accounts for that, but our intelligence and growing sense of responsibility require us to correct that condition. We have not owned the place long enough to have made a full survey or investigation of what it contains.

We certainly have a fine property. We own half a continent extending one-sixth of the way around the globe. From the Atlantic westward we have 1,000 miles of land, with possibilities which no man can adequately describe, as a place for homes for a dominant people, a people dominating others not by suppressing them, but by lifting them up to our level. That area, 1,000 miles wide, is characterized in its natural resources by two important qualities that indicate great things for our future,—soil and climate conducive to the growth of apple trees in vigour and abundance, and the summer air fragrant with clover blossoms. These mean possible homes for many families and plenty of children, with the fertility of the land perennially renewed by clovers. Farther west come 1,000 miles of rock and lake and forest; a wilderness so far as agriculture is concerned, but such a wilderness is not a useless part of the earth's surface. I look upon that as Canada's great regulator of climate for ensuring regular and dependable rainfalls in summer, and, if that vast area

be burned over and left bare, the winds sweeping over it will go where they list, licking up the moisture instead of dropping down refreshing showers. Ontario, Quebec, and the Maritime Provinces, equally with Manitoba, Saskatchewan and Alberta, are concerned in conserving that regulator of our greatest material need—a reliable dependable climate with frequent rainfalls in summer.

Then we have 1,000 miles of prairie soil enriched by thousands of years of nature's far sighted economy, when she stored it with plant food immediately available for crops. There is a tremendous temptation for first settlers to become surface miners instead of real farmers who use and husband the treasures of the soil. The lure of the prairies is like unto the lure of the Yukon or the lure of the Cobalt: "Come and take something, ship it out and make yourselves rich." Surface mining is not agriculture; agriculture is something different; it is conserving the substance and fertility of the soil while taking a liberal toll of crops for our own sustenance and improvement. Over these western plains there is a great deal of good agriculture, notwithstanding the temptation to take from the soil its immediately available wealth. I think this Commission can strengthen the hands of these people by showing them that immediate profits to the largest extent can be obtained from good agriculture while conserving the crop-producing power of the land for the benefit of our descendants.

Between the prairies and the Pacific ocean we have 500 miles of mountains, where not devastated by fire, carrying timber of untold value and rich with minerals, precious and common; while the valleys produce crops from wheat to peaches and all those fine fruits that give us not only nourishment, but delight. A great asset is that stretch, 500 miles in breadth, of mountains and fertile valleys.

That is a hurried and brief survey of our estate, not in acres, but in areas of the half-continent. It is worth while taking care that it shall pass on, not merely undiminished and unimpaired, but improved and enriched by intelligent labour and good management.

May I say a word in a general way regarding agriculture? The object of agriculture, of course, is crops; crops the best in quality and the largest in quantity that can be obtained. I would not think it at all prudent to enter here upon a discussion in detail of the processes and operations of agriculture, but would ask you to join me in considering what we obtain and may continue to obtain in even greater plenty from our agriculture, while I drive a few stakes of statement here and there on which to present suggestions and evidence regarding the conservation of these resources.

Crops—crops for food; and all our foods, with the exception of fish, come from some farm; tea and coffee, as well as bread and butter. One does not want to magnify the place and function of food in human affairs. It is worth saying, however, that a nation's greatness and its success rest upon its food and its ideals, and the poorly nourished people will be at the will of the well-fed race. The race that can utilize its resources for food for the wholesome nourishment of its children and its adults and for the development of energy in the highest realms, becomes a great people. It is worth while remembering that human life and human ideals at their best rest upon the basis of a healthy body nourished by plain, wholesome food. The raw materials for our clothing, with the exception of furs, come from the farm; and furs may be included in the survey of this Commission. Our animal servants that are bred and reared for our pleasure and for our comfort, come from the farm. What man lives who, having learned to ride in youth and having often been the partner in trot and canter with a spirited horse, has not got some kind of education that makes him more capable among men? In learning to dominate the lower animals by intelligence and kindness does there not come some ability to lead the

higher by similar means I like to think of a rural people that know how to ride. It is worth while as part of education. We get many other things from farms: flowers, which we do not eat, but which furnish real pleasure and inspire us with sentiment—lovely and sometimes lofty. "Consider the lilies how they grow." How much poorer we would be in much that conduces to beauty and strength and goodness, but for the richness of thought that flowers bring to us. Tobacco: I do not know that I have ever advocated the growing or use of tobacco, but I believe, as the founder of Macdonald College once said to me, that all from tobacco has not gone up in smoke. Drugs: We get even drugs from the farm. That is a brief survey of crops. Agriculture is for the gaining of crops, and the gaining of the best crops from a constantly improving soil depends upon the capacity and quality of the men.

Agriculture is not breaking clods or moving soil by hand or by machinery; it is the care of the surface of old mother earth. It is a task for men of the large vision, men of stout heart, men of kindly good-will towards their fellows. Out of their labours also abideth these three: faith, hope and love. The task of the race for many thousands of years has been to take care of old mother earth and make her a better home for children. Why the railway, why the art gallery, why the library, why the steamship, why the Dreadnoughts, why anything, but that the face of old mother earth may be a better place for homes for children? And the best result of all the effort is found in the culture of the farmer and of his family by intelligent labour. From the best agriculture comes the culture of the rural population, not only for this year's crop and next year's crop, but for the conservation and transmission of all they have acquired and achieved and become.

Crops in themselves represent labour and management, sun energy and materials. When a man sells a bushel of wheat he sells a small portion of the earth's surface, plus air and sunshine, plus labour and management. The processes which led up to that transaction are called cultivation. The best cultivation means the suppression of weeds, the control of injurious insects, the restraint of damaging disease; it implies the preservation of fertility and the increase of beauty. That is the essence of good cultivation, of good culture, wherever you find it whether on the fields or in human affairs. You will agree with me that agriculture includes the maintenance of an intelligent, capable, prosperous and contented rural population. I cordially agree with the thought of our chairman yesterday in which he indicated the great value to the nation of an intelligent rural population carrying forward their work and maintaining which great leaders and patient workers have come in all ages. If Christ had not been born in a stable and cradled in a manger, I believe some great seer with power of interpretation would have invented the story to make it fit the facts of human experience.

Agriculture plays a great part in changing the forms and altering the values of materials and energies for human service. The primary sources of all crops that come through labour are the sun, air, water and soil. The contributing factors for crops are: soil, air and climate (which, after all, is not so elusive as to escape wholly the intelligent domination of the good farmer), seeds, labour and intelligence. These four—soil, air and climate, seeds and intelligent labour are the constituent or contributory elements or factors for crops. The soils are merely broken down or broken up portions of the earth's rocky surface. The crust of the earth is not very thick. If some strange power, natural or supernatural, should come along with a jolt and upset the island of Montreal—well, the eastern end would be down in the molten, while the upper end would be with Macdonald College and the snow. That is about the thickness of the crust according to the statements of latest scientific imaginations; and the soil on it is still in the making in different regions at the rate of from

one-tenth of an inch up to one inch per century. Soil fairly represents the rocky crust of the earth in its mineral or inorganic elements. The organic parts of the soil are the decaying remains of bodies which were once alive—roots and leaves and stalks and flesh and bones. All flesh is grass and all grass was sun, air, water and soil; and thus the rotation goes on. The decaying remains of things that once lived and the atmosphere are the source of nitrogen for crops. Nitrogen is one of the most important constituents of the flesh-forming parts of foods as distinguished from the starchy parts that give us heat and energy.

The soil contains living organisms at work. Soil is not a wholly dead thing, not the soil for crops. It is alive to the extent that it is the home of myriads of living things. Earth worms were the necessary forerunners of human life. Their function was the digestion of the crude elements of plant food, thus preparing the constituents necessary for the life of plants, which, in their turn, sustain the higher forms of life. Millions of bacteria also live in the soil, and, but for their labours, crops would soon cease to grow. All the available nutrients would very quickly be exhausted but for the continuous labours of these lower forms of life. By cultivation and good management the farmer can increase the population of his soils by many myriads of bacteria per cubic inch in the course of a few years. The farmer has a new interest in cultivating land when he knows he is managing life. The main purpose of cultivation is to give the life in the soil a chance to do the best for itself; and in proportion as this is done will the crops prosper. We are all interdependent. No man liveth unto himself. The man who gives the bacteria in the soil and all the other serviceable forms of life a good chance, will thereby provide a rich and profitable opportunity for himself. I think that law runs through the whole realm of nature's economy.

Water also is a constituent of the soil for farm purposes; it is not something extraneous and foreign. The rocky portion of the earth's surface broken down, the decaying remains of organisms, bacteria and other forms of life and water—these make soil. The series of changes, chemical and physical, which go on are due to the life and activity of these organisms in the soil. They are the cooks, without which plants cannot find their nourishment, even though it may be there in the crude form not far from the roots.

Certain substances are essential to plant life and plant growth, and these are only ten in number. The two chief constituents of farm crops are oxygen and carbon. These come directly from the air where they exist in unlimited quantities. Hydrogen is a constituent of water, and so long as there is plenty of rainfall or water in the soil there is no scarcity of that element. Nitrogen, a valuable constituent of plant food, comes directly into plants from the air by previous processes of growth followed by decay. There is plenty of nitrogen close by; over every acre there rests enough for 1,500,000 average crops of cereals. Since it may be taken into crops of the clover family through the agency of bacteria which live in the roots, the supply may be reckoned as inexhaustible when the agencies are effectively used. Once captured and combined into a plant, it may be kept in rotation through plants, animals and manures indefinitely.

You may remember the statement by Sir William Crookes that there was a danger that the nitrogen of the soils might be too scant for producing sufficient wheat crops. We learn from recent investigations that by means of the life of bacteria on the roots of clover, alfalfa and other legumes, the nitrogen is taken in direct from the air and thus prepared for use by other crops. By that process we can call on the free nitrogen of the air to the extent of our intelligence and our ability. That element is available in abundance subject to the limitations of our intelligence and our labour.

The other elements required by plants are phosphorus, potassium, magne-

sium, sulphur, calcium and iron. If the first seven inches of the soil are of the average composition of the crust of the earth, then the amount of phosphorus present is enough for average crops of cereals for only 250 years; and that is not a long span in the life of a nation. We run some risk of being short of that element, and if a crop is short of any one of these elements it cannot make use of the others; the crop is held up for want of nourishment and cannot go on. On the average the phosphorus in seven inches of the earth's surface represents enough for about 250 crops such as wheat; the potassium represents about 5,000 crops, if it could be all taken out without renewals; the magnesium represents 14,000 crops; the sulphur represents 20,000 crops, the calcium represents 100,000; and the iron 400,000.

There are only three elements likely to be deficient in agricultural soils, namely, nitrogen, potassium and phosphorus. Analyses by Dr. Frank T. Shutt, of the Experimental Farm, which are very comprehensive and among the best on the continent, give us the information that in the top foot of the good lands in Canada there is enough nitrogen for 150 large crops of cereals without renewals, and phosphorus for 250 crops. You see, we are within measurable distance of the exhaustion of nitrogen of potassium and phosphorus unless we have constant renewals. Only a small proportion of the total quantity of these elements in the soil is in available form at one time; they are mainly in a form not soluble and therefore not get-at-able by the plants. In fact, a very small proportion of what is present is ready for the use of plants; otherwise the rains would wash them out and leave the soil poor. While I have no desire to compare to the disadvantage of the mother-land the conditions there and here, it is worth mentioning in this connection that when the frosts of Canada seize the soil at the end of the growing season, all the soluble plant foot is held fast in its frozen grip until spring, whereas in England the wastage into the sea between November and March on cultivated land without a growing crop, is sufficient to feed one whole grain crop. The frost of winter is not altogether a handicap; it holds the available soluble constituents of plant food and leaves them in position and condition ready for the use of the crops in spring. England could not have gone on reaping such harvests but for bringing on to the land these constituents in abundance by importations from other countries. She makes all lands pay tribute to her soil by her imports of foods and fertilizers. She can spare much leaching to the sea and never miss it. We cannot afford to do that.

Nitrogen can be supplied by manure spread on the land and by the growing of legumes. The application of manure will liberate by fermentation the potash as nothing else does. The supply of potash in the soil can be renewed by putting back on the land the manure from all the crops removed, or its equivalent. The phosphorus is somewhat deficient, and there is great danger for the future of farming in Canada unless we conserve that and put it back on the land.

The rotations of crops so generally advocated furnish for the next crops the decaying portions of roots and stalks and leaves. These may be the home for bacterial life. We must not forget that soil, which we formerly thought was dead, is the habitation of bacterial servants who work for us and, in supporting themselves, do tasks which we could not otherwise have performed at all. The rotation of crops first of all furnishes suitable conditions for bacteria. The humus or decaying organic matter also makes the land retain water, and this enables plants to obtain their food. Rotation of crops cleans the land from weeds; a most important function. It also cleans the land from what seem to be poisonous substances, which, in some little measure, so far as our latest investigations show, a crop leaves as its by-product in the soil. Clover sickness is not a grotesque notion of the ancients. We know that the by-product of one form

of life, unless disposed of somehow, would make it impossible for that form of life to keep on living there. You may have five people living in a small valley for all time and thriving on the fruits, drinking pure spring water and rejoicing in all the surroundings; but let 50,000 people camp in that valley for a fortnight, and the by-products in their sewage may make the continuation of healthy life for them impossible. Sensible rotation puts in another kind of crop after oats, wheat or barley to renovate and purify the soil for the next crop. That also is a part of the conservation of labour which is worth thinking about. Rotation of crops also cleans the land from forms of injurious insects. It is not generally known by farmers that the two-and three-year old wire worm is the fellow that cuts the oats, and he cannot get to be three years old unless the pasture or hay is down for that length of time. If you can kill all the two-year old wire worms and white grubs by rotation, their power to do damage will be greatly reduced. There is a great conservation of labour and skill in getting at your foe in the right time. The distribution of labour over the whole season is a valuable plan in national administration. It is important that our people on the land should be occupied the whole year round rather than be rushed in the spring and harvest, with a temptation to loaf and rust during the rest of the year. Once, in Manitoba, I met a farmer on the train going west and asked him: "What are you going to British Columbia for?" His answer in substance was: "I cannot stand this long winter doing nothing." There is no salvation for man but in labour; if he wants to feel satisfaction within himself, labour in some form spread over the year is necessary. I restate part of the case for the rotation of crops in the following paragraphs.

It is admitted that the rotation of crops has been the chief means of improving the agriculture of Great Britain and some other portions of Europe during the last century. The practice itself consists in growing roots (or some other cultivated green crop) and leguminous crops (such as clover, beans or peas), or grass (or hay crops, alternately with cereal crops ripened for grain. The famous four-course Norfolk rotation was roots, barley, clover or beans and wheat. The chief point seems to be to make each of these crops follow others which have different requirements with respect to the time of the season when they benefit most by plenty of available plant food in the soil, and different habits of growth in other ways, particularly in the ranges of their roots. The rotation for any farm must have regard to the soil, the climate, the markets for crops and other local conditions. Not only the increase in the yield of crops has to be taken into account, but also the value and uses to which the crops can be put when grown.

Clover is a most valuable crop for use in a short rotation. It increases the substances of plant food in the soil for cereals, and makes conditions suitable for the activity of such germs in the soil as prepare other substances for the use of subsequent crops. The use of a clover crop, or some other plant of the same family—one of the legumes—in a rotation, has been demonstrated to be the best farm practice. In an experiment extending over thirty-two years, at Rothamsted, the records show an increased yield of wheat amounting to 114 per cent. when one crop in the rotation included clover or beans, as compared with the yield from wheat when cereal crops followed cereal crops.

The results on the experimental farms of Canada show that the yield of grains (wheat, oats or barley) after clover is from two to ten bushels per acre more than the yield of grain in the same season after a previous grain crop. The great increase in crops grown in rotation over those grown continuously seems to be because more nitrogen is available to the former; and perhaps because it is available during the early period of their growth from the preparation of it by the preceding crop or by the cultivation of that crop.

Other benefits from systematic rotation of crops are:—

(1) The distribution of the mechanical operations of the farm over the season; (2) The opportunity for cleaning the land; (3) The comparative freedom from damage by insects; (4) The production of a variety of products for feeding to live stock and for sale.

Now let us consider climate. The end of the whole process and effort and plan of agriculture is not changing the condition of soil, as in the forest primeval or in the unbroken prairie, to a cultivated surface. It is not breaking clods or moving soil; it is gathering sunshine into humanized wealth. Agriculture organizes wealth in humanized and usable forms out of what otherwise would continue as wilderness. The soil is only one of the means whereby the intelligent labour of man finds expression in crops. Seed is one of the means. Water is another of the essential means. If any one of these is defective or deficient the success of the human effort towards expression in crops is hindered. For every ton of dry matter that comes into our granaries there went through the plants 300 tons of water. Does not that commend to us a careful consideration of the conservation of that big forest reservoir up in the wilderness? Every ton of dry matter from the corn fields and the oat fields of Ontario and Quebec and the wheat fields of the West means that the plants transpired at least 300 tons of water. Therefore, the immense advantage of frequent showers in summer and of retentive soil that water may be available when and where the plant needs it, is plainly evident. The farmer is the manager of these means to capture the sunshine. His main business is the catching and converting of sunpower into food and clothing for the human race.

The temperature of the first three inches of the soil is, to some extent, determined by the method of cultivation; the land may be warmer from being drained and properly cultivated than if left uncared for. The sunshine can be gathered into the crops earlier in the season by means of early ripening varieties. As to wind-storms and hail-storms, the wind bloweth where it listeth; but wind-storms and damaging rain storms and hail-storms do not often come where intelligent forethought and labour have set out and cared for trees and maintained the forests as a useful ally of agriculture.

It has been considered by many that the wastefulness of pioneers is in keeping with the prodigality of nature, and that the pioneer had the right to dissipate natural resources if he thereby improved himself and the prospects for his family. Take an illustration in a large way from the use of coal. During millions of years it was prepared and then stored in the earth—we suppose for human use. And we have been using it with fine prodigality, boasting of the millions of tons we mine every year. Yet we learn from some authorities that the probabilities are, that in seventy-five years the coal deposits of the United States will be pretty well exhausted, except those at the lower levels, more difficult of access and more costly to obtain. It seems all right in the meantime to be using up the coal which has given man, to a large extent, control over metals and the knowledge of and control over electrical energy. Thereby he has acquired ability to apply to his own service the inexhaustible resources of water-powers; and perhaps, by and by, he may be able to use sun-power direct. By harnessing the water-powers of the country we now generate heat, light and power from them, which man could never have done, as far as we can see, except for the use he made of coal in a large and liberal way during all these years of experimenting. There is a justification, if you please, for the extravagant use of that great natural resource, because of what has resulted from it. But when man exhausts the soil, what does he do? He helps to make the people more careless and less competent; he leaves them less power and more poverty in every respect. On the other hand, when he preserves and increases the fertility of the soil, the people thereby become increasingly efficient and capable. These two go together. It is for us to see that the fertility of our soil shall be

maintained, and that there shall be continuously improving conditions for the rural population.

Already in our brief term of occupation the soil fertility is somewhat depleted. Is there no warning in the fact that the average yield of wheat per acre in the United States is only about one-half of the average yield per acre in old England? Let us see that the man on the land is informed of the difference between the privilege of the pioneer miner to be extravagant and seemingly wasteful, and the duty of the pioneer farmer to conserve the fertility of the soil. The greatest want on the farm is want of useful knowledge. Ignorance is always the mother of vice. Vicious farming is not done with malice aforethought: it is an inevitable outcome of ignorance regarding nature and her ways.

Seeds are important. The crops of Canada, in 1909, of wheat and oats and barley called for about 33,000,000 bushels of seed grain. Some years ago a competition was carried on in 450 places in Canada to determine the results obtainable by sowing selected seed. If you reason from the results, you shall find that an increase of 190,000,000 bushels of oats, wheat and barley might have been obtained by this one means, alone, in 1909. I do not say that improvement is immediately practicable or possible; but I do say it is attainable when all the fields of Canada are sown always with clean, well-selected seed. I can hardly realize what quantity 190,000,000 bushels represent. The figures by themselves do not convey clear, definite meaning; but I know that the quantity they represent is more than four times as much as all the grain and flour that went through the port of Montreal in any season before 1909. What a possibility of extending and expanding commerce. That 190,000,000 bushels of grain would fill 1,500 miles of railway grain cars. We are gradually, very gradually and slowly, coming to see the importance of pure seed.

One word more about the seed. We require seeds that suit the soil and climate. No man can tell without trial that a seed will fit into any particular set of conditions; but, so far as we know, the plant that has proven its ability to do well, to do the best of any of its kind in a locality, will give the seed that will produce the plant there again which will thrive best in that locality. The work of the experimental farms, particularly the work done by Dr. William Saunders, Director of Dominion Experimental Farms, and by Professor C. A. Zavitz, at the Ontario Agricultural College, is highly valuable. The work of the Seed Branch of the Department of Agriculture and of the Canadian Seed Growers' Association has also been exceedingly useful. Even in the few years that Macdonald College has been in existence, Professor Klinck has perfected an Indian corn for fodder and for ensilage which thrives admirably in Quebec. The experiments on the Dominion Experimental Farms have given the farmers of the West control over the climate to the extent of escaping frosts in great measure by means of varieties of wheat which will ripen some days earlier than was formerly the case. The work of the Ontario Agricultural College has given a barley to Ontario which yields on the average some four bushels more to the acre than any other variety so far known. A strain of barley especially well suited to Quebec and the Maritime Provinces has been evolved by Professor Klinck at Macdonald College. These are already achievements in the right direction.

Labour must also be considered. It is essential that labour, to be excellent and economical, should be performed by healthy people. The water supply of the farm houses has much to do with the labour of the people. Less attention is paid to the water supply of farmhouses than to that of other dwellings. While this would not be the occasion to discuss the pollution of streams generally, a reference must be made to the waste and the danger from allowing the sewage from cities and towns to escape into streams. Common opinion says that the stream purifies itself. Well, the sewage of Ottawa goes down past Macdonald College, a hundred miles distant, about four and a half days old, and it is not

impaired in the vitality or vigour of its bacteria. I don't like that kind of water for drinking purposes. Why should anyone? This subject affords a great field for thought and action. The fact that the old farm well was put near the house without any reference to the drainage and seepage from the barn, the stables and the house itself, is in evidence everywhere. Typhoid on the farm—that old graveyard in Scotland holds my oldest sister and my oldest brother because we did not know the danger. Now that we do know, should we not protect our people? The farm home should be a place where typhoid and scarlet fever are unknown. Why should there not be a bathroom in every farm house? I would not live on a farm if I could not get the wholesome comfort of a bath daily and I am only one man in many. Numbers of men who might enrich the nation's life would not live in the country without a good water supply on tap in the house. It can be had on every farm at small cost. How many men think of the value to the housewife of having running water in the house, to save her steps and give her pride in her home? We know that the pride of women in their own homes and families is a means towards national greatness. Anyone who has looked into the quality and sources of life and power knows something of the influence which the hopefulness and joy of the mother exercises on the vigour and spirit of her sons and daughters. The placing of a good pure water supply in farm homes is a conservation of one of our greatest agricultural resources.

We have made some headway at Macdonald College in considering the application of wind-power to the heating of homes on the prairies where the wind blows 20 hours a day. Can it not be turned into mechanical or electrical energy to give heat units to warm and light the house? In Canada we are away behind other countries on some of these matters. That is why some of us look to Switzerland and Denmark and Sweden to gain from their experiments and experiences lessons of real value. In some respects we have been so self-satisfied in Canada from self-laudations that we have not made earnest efforts to learn. Why should we not light and warm our prairie houses from the wasted energy of the winds? Cannot we grow special crops that will provide fuel close by? Maybe we can improve the sunflower until the stalks give us fuel and the heads a greater percentage of seeds and oil than before. Maybe an intelligent application of research and labour will enable us to utilize and conserve these resources.

Is intelligence in or for labour inherited? I do not think so. Every man is as lazy as he dares to be; that is what he inherits; and he is just as selfish as his education lets him be; that is our civilization. We cannot get intelligent labour by intuition; it comes only by instruction and by illustration and by training. The grown man is almost as susceptible as the young man to a form of instruction adapted to his years; you can provide means of education and training for him in a form in which he will take pride. When a man is old he is not past being educated, but the means must be acceptable and adequate. He will respond to illustrations of a system of farming which will be profitable to the farmer and his family while not reducing the crop-producing power of the soil or spoiling the beauty and attractiveness of the place. One of the problems of humanity is to maintain fertility by the activity of plants and bacteria while gathering a generous living from labour.

There is a vast field for the application of intelligent methods in the suppression of weeds and insects and diseases, and in laying the hand of intelligent control upon all our foes inside and outside. Insects alone take toll of our crops to the extent, perhaps, of 10 per cent. of their value. The magnitude of this toll can be realized from the fact that the field crops in Canada last year had a value of $532,000,000. If we cannot save all of this toll, we can save part of it by trying to bring into farm labour more and more intelligence regarding our natural resources and their management.

What are we doing as a people commercially and industrially with these

agricultural resources? Last year in Canada (I quote from the excellent report and data provided by the Department of Agriculture) last year in Canada we grew on 30,065,556 acres, field crops to the value of $532,992,100 at local market prices. What could be done with that? It will feed our own people in the main, and the surplus will furnish the basis for a vast national commerce, domestic and export. It will furnish freight for railways and steamships, and the revenues and savings from it will furnish capital for banks and for business, and pay the wages of thousands and thousands of employees in our manifold industries. In part, we pay our outside debts by our exports. To every hundred dollars' worth of exports the main industries contribute as follows:—fisheries, $5, manufactures, $12, mining, $15, lumbering, $16, and agriculture, $51. That is the way we pay what we owe outside.

There is evidence that we are getting more crop from the same land, apart from the question of whether we are depleting the soil of its fertility. Take wheat as a typical farm crop. We are doing fairly well in Canada because we are bringing virgin land by the million acres into crop, and that keeps our average up. The average in the United States last year (one of their big years) was 15.77 bushels to the acre while the average in Canada was 21.51 bushels to the acre, or about 5¾ bushels to the acre more than the average yield of the United States. The average in Russia was 8 bushels to the acre: and in Germany in recent years the average has been 29 bushels to the acre. Even in these long cultivated lands in Germany, not new virgin lands, there is a yield of some 10 bushels to the acre more than there was 25 years ago as the result of the application of more intelligent methods and better management. But what has Germany been doing during those 25 years? She has been importing wheat and such grains and exporting sugar, which takes out sunshine with carbon and water gathered through plants from the air. Sugar does not carry away any valuable plant food.

Denmark has been doing the same—importing wheat and corn, oil-cake and bran (which, by the way, we exported to the value of $888,900 in 1909) and such like, and exporting chiefly butter, bacon and eggs. The butter imported into the United Kingdom from Denmark was reported as 197,571,024 lbs., worth some $49,802,400, in 1909; and that $50,000,000 worth of butter carried less out of Denmark of the elements of fertility than did 1,000 tons of hay shipped out of Quebec. There is a contrast in the national administration of agriculture—$50,000,000 worth of butter impoverishing the land less than the export of 1,000 tons of hay, worth at the outside $14,000. In Hungary, on one of the large estates of which correct records have been kept, the increase in the yield per acre has been remarkable. Between 1851 and 1860 the yield of wheat was 10.9 bushels to the acre, and between 1891 and 1900 the average yield of wheat was 30.3 bushels to the acre. During 1851-1860 the yield of barley was 14.7 bushels to the acre: during 1891-1900 it was 43.9 bushels to the acre. The yield of oats was 17.1 bushels to the acre as against 51.3 bushels to the acre. The yield of Indian corn was 21.3 bushels to the acre during the former period, as compared with 41.6 bushels to the acre during 1891-1900. This has been brought about by intelligent and intensive cultivation instead of by following primitive methods.

And in England, dear old England—in England, big enough to represent in its own name the Empire of which I am proud to be a citizen: in England, not merely the mother of parliaments, but the mother of liberties for mankind all round this good old earth: in that kind of England with its sturdy agricultural population, the yield of wheat has been 31.39 bushels to the acre on the average for ten years. Last year (1909) it was 33.68 bushels to the acre. And in Scotland—that little land which modestly admits the ability of her own people—in Scotland during ten years they got an average of 38.86 bushels to the acre, and last year 41.19 bushels to the acre. Not so bad for the old land.

It is written that 200 years ago England was harvesting only 8 bushels of wheat to the acre. The records of those ancient days are somewhat conflicting, as 26 bushels per acre were reported in the sixteenth century. This much is certain, the yield per acre now and in recent years is higher than ever before.

What did England and Scotland do? They imported foods and feeds, guano and other fertilizers. They were importing guano for the land in my early days on a Scotch farm. I doubt if I could have had as good an education as was my privilege but for the guano on the farm, which enabled us to take good crops from a reluctant and difficult soil. Will it pay Canadian farmers to do the same thing or something else to maintain phosphates? I think we are nearly at the point where we must consider that carefully. Phosphates are becoming scarce.

Our agricultural resources must be considered not only from the standpoint of the farmer following a particular occupation for profit, but also bearing in mind that agriculture is a great public interest, a great productive business having an influence and bearing upon the fortunes of the nation, the Empire and the race. Agriculture is one of the great mothering occupations for the maintenance of civilization. Three fundamental activities mother and nurture all the others in our civilization: farming, whence arise many good things; making homes, the object and glory of nearly all human effort; and teaching the young that may have a correct knowledge of nature and a sound knowledge of human nature.

While it is easy in the case of Mines and Fisheries and Forests and Waterways and Water-Powers to do something definite by means of regulations laid down by legislation, it is immensely more difficult to accomplish much by that means in the case of lands, because the ownership and control are in the hands of multitudes of individuals each acting singly and independently. But because it is difficult it is none the less needful, nor should it be the less a task to which we should apply ourselves.

Can anything more be done to attract our own people to stay on the land, particularly to keep the young men and young women satisfied on the land? What are other peoples doing, and with what success? Let us find out. Denmark has done much with apparent success in luring to the land and in retaining on the land the best of her people. Co-operative associations have brought about business good-will as well as good crops and good prices. Can anything be done to make social life on our farms more satisfying? Can anything be done to give the women in the homes on the prairies a better chance to rejoice and be glad that their lot is cast there? Can anything be done to bring about an increase of home industries, not merely for profits, but for contentment and satisfaction through the industrial habits of our industrious people?

How shall we learn how others have learned the lessons of cause and effect and applied these lessons? Should we not in addition to an inventory of our possessions have records and illustrations of the best use that anyone has put them to, in order that a similar, if not identical, use may become the common practice? That is necessary to our people in order that they may be inspired and guided.

We want a record of our wastes, as well as of our conservations. We want such records and illustrations in a museum, national in its scope and service. That would be a useful institution. We want not a place full of dead specimens, but a place for the suggestion and nourishment of living thoughts and new policies. We want records and illustrations of all our resources. Then, by the diffusion of knowledge through various means, we will be led to adopt measures for conservation and for improvements in utilization while we are prosperous. Everybody might then have some guidance from some knowledge of the operations of the best farmers, of the principles of the truest scientists and of the

policies of the wisest leaders. In some such way shall statesmanship in agriculture ensue the perpetual well-being of an intelligent people animated by goodwill and rooted in land well tilled and beautiful. That, I think, might be to us a vision, as it should be an incentive to help in the making of the new earth wherein dwelleth righteousness.

WEDNESDAY AFTERNOON.

At the opening of the meeting in the afternoon, the Chairman called to the chair Hon. Ward Chipman Hazen Grimmer, Surveyor General of the province of New Brunswick.

Hon. Mr. Grimmer: The proceedings this afternoon should be of very great benefit along the lines to which the gentlemen who are to speak will address themselves. The gentlemen who spoke this morning covered by their addresses only a small branch of what is to be done as the work of this Commission, but what they said shows the importance to Canada of our work.

The Chairman then called upon Dr. Eugène Haanel, Director of the Mines Branch, Department of Mines, Ottawa, who read a paper on

POSSIBLE ECONOMIES IN PRODUCTION OF MINERALS OF CANADA.

Dr. Haanel said:—

There is this difference between mineral resources and other natural resources, that while a forest cut down may be replanted, an exhausted soil, refertilized and a river or lake depleted of fish, restocked, an ore deposit once worked out can never be recovered.

We allow ourselves great latitude of language when we speak of this or that deposit as being inexhaustible. The economic mineral deposits accessible to man are finite in quantity, and the time required for their exhaustion depends solely upon the rapidity with which they are exploited.

The immense pressure exerted by the acquired needs of modern civilization, reinforced by the commercial spirit of the age, will render futile any effort that might be made to curtail the exploitation of the mineral resources of the world. We can pass no laws for a close season in mining, during which mines or smelters should cease operations. All that we can do is to employ such methods in mining that no waste shall occur. The mine must be worked out: nothing valuable must be left behind. Existing methods require to be perfected, or new ones invented, to enable us to discover new mineral deposits at present buried out of sight. The problem of successfully substituting for certain vanishing resources others which are still abundant and capable of taking their place, will have to be solved. Metallurgical investigation must be directed to the invention of processes which are capable of handling economically lower and lower grades of ore. Much is being done in these directions, as will appear later.

Only a few years ago ironmasters on this continent would hardly look at an iron ore if it contained less than 62% of metallic content; now an ore of 50% is gladly accepted.

Iron—The question of the world's supply of iron is of such grave importance that the International Geological Congress has invited some twenty-six different countries—Canada among the number—to prepare estimates of their respective iron ore resources to be presented at their meeting at Stockholm next summer. This action of the International Geological Congress is an indication of

the general anxiety and uneasiness created by the enormous demand upon this resource, for which there is no substitute, and without which modern civilization cannot continue.

But, whatever the fears regarding the world's future supply of iron ore, this pessimistic outlook does not apply to Canada, for at the present time, we are dependent upon other countries to supplement our own product by importing of their iron in the crude and manufactured state to the value of about $62,000,000 annually. In 1908 it was $61,819,698. We thus see that conservation of Canada's own iron ore resources has, unfortunately, been practised only too successfully. We are, and will continue to be, industrially handicapped until our iron industry is developed sufficiently to meet the demands of our own country and render us independent of outside sources for this all-important metal.

What we need is not conservation of our iron ore resources, but vigorous development of our iron industry. The very fact that the Government has been, and is, giving a bonus on pig iron and steel produced in this country shows how great is the need for such an industry.

By the methods hitherto employed in the production of pig iron and steel, cheap metallurgical fuel was a necessity; hence blast furnaces could only be erected and do a successful business where iron ore, coal and flux could be cheaply assembled. This is possible, however, only in the extreme east and west of the Dominion.

The middle provinces, though possessing iron ore deposits and fluxes, lack the needed metallurgical fuel. The development of a vigorous iron industry, with coke at $5.00 to $6.00 per ton, could not be looked for in these provinces, if it was necessary to depend on blast furnace methods.

The comparatively recent investigations of the electro-thermic process for the smelting of iron ores have demonstrated that only one-third of the carbon necessary in the blast furnace is needed in electric furnaces. This brings the cost of the metallurgical fuel required for smelting down to a reasonable figure. The adoption, therefore, of this process would lead, not alone to the utilization of our domestic iron ores in the provinces of Ontario and Quebec, but would greatly conserve our fuel supply by substituting hydro-electric energy for the heat energy of two-thirds of the carbon required in the blast furnace.

It may be interesting to state briefly what has been accomplished up to the present time in the development of electric smelting processes. It is only five years since the Commission appointed by the Dominion Government to investigate the different electro-thermic processes for the smelting of iron ores and the making of steel, which were in operation in Europe, presented its report. There were then only five small electric steel furnaces in existence, and only two of these were seen in actual operation. To-day seventy-seven are in operation in Europe, and a number have recently been erected in the United States, some of which are of fifteen tons capacity. Indeed, electric steel is rapidly pushing crucible steel out of the market. Italy and France have the honour of having been first in the field to apply electricity to the commercial production of steel. Germany, which had no part in the original invention of the electric steel furnace, has recently been especially energetic in the adoption of the electro-thermic process for the production of steel and in the modification and improvement of existing patents.

While engaged in superintending the electric smelting experiments at Sault St. Marie in 1906, I noticed that the yard adjacent to the rolling mill was covered with many tons of the waste ends of the Bessemer steel ingots used in the manufacture of rails. No use was made of them at the time, and they were allowed to accumulate and eat up interest. An electric steel furnace set up in the works of the Lake Superior Corporation—for which every facility existed—

could profitably have converted this waste into high priced tool steel. I understand that these waste ends are at present being utilized in the open hearth furnaces lately erected.

A process that removes from steel, more perfectly than any other, those deleterious ingredients which render it fragile under shock, and deprive it of its lasting qualities, is manifestly the more economic process. This purification is more effectively accomplished by the electric steel furnace than by any other metallurgical process; its introduction in steel plants is, therefore, in the interests of economy.

It has, within recent years, been demonstrated that, in steel manufacture, carbon is not the only substance which imparts valuable properties to the iron; but that tungsten, chromium, vanadium, nickel, molybdenum and manganese add special economic qualities to iron; and for some purposes, either separately or in combination, are far superior to carbon alone.

A tool made from these alloy steels, which will hold its edge longer under severe stress and do a greater amount of work than another, is the more economical tool. A rail which can stand up longer under severe shock and resist better than another the constant wear and tear of heavy traffic is undoubtedly the more economical rail. It is manifestly in the interests of economy, not alone to employ these alloy steels for the purposes for which they are best fitted, but to manufacture them in furnaces best adapted for their production, namely, the electric steel furnace.

The progress made in the application of electricity to the production of pig iron has been much slower than in the manufacture of steel, since it was feasible only in countries possessing water-powers which could be developed at a reasonable figure. The central provinces of Canada are in this position because they possess the ore, the fluxes and the needed water-powers.

With a view of testing the feasibility of introducing the electric smelting of iron ores into these Provinces, the Dominion Government authorized the making of experiments with Canadian ores. It was not alone proven by these experiments that excellent pig iron could be produced in the electric furnace, but the remarkable discovery was made that, from a refractory ore high in sulphur, a pig iron containing only 0.005% of sulphur could be produced. This is an exceedingly important result, since, by this new process, the large number of sulphurous magnetite deposits which abound in Canada, and which have hitherto been useless, are now rendered available for the production of high grade pig iron and steel. The world's supply of useful iron ores will thus be greatly increased by this electro-thermic process of smelting. The experiments made under the auspices of the Dominion Government at Sault Ste. Marie have been productive of another important result. Roasted nickeliferous pyrrhotite, carrying 2% of sulphur, has been smelted in the electric furnace into a pig iron virtually free from sulphur and containing from 3 to 4% of nickel. About 165 tons of this nickel iron were produced. This is the first instance in the history of metallurgy where the iron content of the pyrrhotite has been saved. Iron pyrites cinders—the sulphurous iron residue of the roasting of iron pyrites in the manufacture of sulphuric acid—which so far have been useless, may now be smelted by the electric process into excellent pig iron. These two instances are brilliant illustrations of the conservation of our iron ore resources.

Immediately after the publication of the results of our experiments at Sault Ste. Marie, Sweden—which has abundance of excellent iron ore and numerous water-powers, but, like Ontario and Quebec, lacks metallurgical fuel—was not slow to perceive the advantage which the introduction of electric smelting would prove in the development of its iron industry. Hence, without hesitation, it proceeded to take an active part in perfecting this method by the invention of a commercial furnace. In the report on the experiments at Sault Ste. Marie, de-

finite suggestions were made as to the lines upon which a commercial furnace should be constructed; and these ideas were incorporated in a furnace designed by three young engineers of the Aktiebolaget Elektrometall of Ludvika, Sweden, who succeeded, after repeated trial constructions, and an expenditure of $102,000 in building a furnace which has proved satisfactory. To anyone who has seen a blast furnace, the construction of this furnace will easily be comprehended. The general design is similar to that of a blast furnace, with the tuyeres replaced by electrodes.

The fact that the output per electric horse-power year with the Swedish furnace did not reach our best results at Sault Ste. Marie is not due to faulty construction, but to want of the proper amount of energy. The capacity of the furnace was at least 1,200 H.P., whereas only about half that amount was available.

Several very important facts have been demonstrated during the summer run with this Swedish furnace. It has been found that it was possible to make an iron containing only 2% of carbon. The essential difference between pig iron and steel is that the former contains up to 4% of carbon, while any iron classed as steel contains from 0.6% to 2.3% of carbon. It will be seen, therefore, that the Swedes have succeeded in producing in the Domnarfvet furnace a high carbon steel direct from iron ore. It has, moreover, been demonstrated that, in the electric furnace, the process for producing iron of different compositions is under more exact control than in other processes. Mr. Yngström, Vice-President of the Copparbergs Aktiebolag of Falun, and a distinguished ironmaster, in his report on the performance of the Swedish furnace after a three months' run, declares that, judging from the tests made at Domnarfvet, the production of iron from iron ore in electric furnaces is successfully accomplished, both technically and economically.

Shortly after the publication of my report on the investigation of an electric shaft furnace at Domnarfvet, Sweden, in December, 1908, I was informed that, at Tysse, Norway, a contract was let for the establishment, on a commercial scale, of an electric smelting plant consisting of two electric shaft furnaces of 2,500 H.P. capacity each, two steel furnaces of 600 H.P. capacity, and a rolling mill. This plant is to be increased by two additional shaft furnaces and two steel furnaces.

Some two months ago the Jernkontorets, an associataion of the ironmasters of Sweden, acquired the patents for the electric shaft furnace of the Domnarfvet type, and are erecting a 2,500 H.P. furnace of similar design, with a probable output of 7,500 tons annually, at Tröllhatten, Sweden, for the purpose of demonstrating to the iron ore owners and ironmasters the class of iron which can be produced from the different Swedish ores, and at what cost.

Mr. Boholm, of Trondhjem, Norway, writes me that he is desirous of erecting iron and steel works in Norway, and asks my Department to furnish him with an electro-metallurgist to take charge of the plant.

Canada has done all the pioneer work in connection with the process of electric smelting of iron ores, only, however, to benefit other countries, who have not been slow to perceive the advantages of this process. Italy, Hungary, Russia, Brazil, India, South Africa, Mexico and California—conditioned similarly to Ontario and Quebec as regards the iron industry—are becoming increasingly interested in the subject of electric smelting, judging from the persistent applications made to my Branch for reports and information.

Before leaving this subject, I would like to call your attention to a special method capable of wide application in the delimitation of magnetic ore bodies, which constitute our most abundant iron ore deposits. This method is described and explained in my report upon the location and examination of magnetic ore bodies by magneto-metric measurements, published in 1904. By means of this

system we are enabled to locate magnetic ore bodies buried out of sight by soil and to determine their general extent and inclination to the horizon. This latter information is especially valuable, since it enables the mining engineers to locate accurately their bore holes for the purpose of proving the deposit. Under favorable circumstances, if the ore body consists of compact magnetite and the surface is fairly level, it is also possible by this method to determine the extent of the ore body beneath the surface and the depth to which it descends into the earth.

This method has been applied by members of my staff for the past seven years, and has been of great service in determining the extent and probable value of the magnetic deposits examined. In one instance a deposit which had been condemned as of no value, proved, on examination by the magnetometric method, to be of considerable extent. Bore holes were located by our engineer, and it was found that the deposits, on the most conservative estimate, contained some eight million tons of ore.

The publication of our magnetometric survey maps has attracted the attention of iron ore experts in other countries, notably Dr. Leith, of the United States Geological Survey, and Dr. Phillips, of the Bureau of Mines of the University of Texas. Both these gentlemen have made application to the Department for the services of one of our experts to instruct members of their staff in the application of the magnetometric method. As this system becomes more generally known and practised, valuable magnetite deposits, which now lie hidden beneath the soil and forests, will be added to those already known, and will thus tangibly increase the general stock of this all-important metallic mineral.

When in the vicinity of magnetic ore deposits, the magnetic needle of surveyors' compasses is always disturbed, and its action becomes erratic. Such occurrences, whenever met with by the surveying staffs of the Government, should be reported to the Department of Mines, for there magnetometric surveys might be advantageously made.

Zinc—For some years the zinc ores mined in British Columbia found a ready market in the United States. The recently erected tariff of the United States has, however, virtually closed this market. If the ore mined is not to lie profitless on the dump, some method requires to be devised which will successfully treat these ores and enable the mine owners to export the output of their mines as a finished product, either as spelter or zinc oxide. In the hope of accomplishing this much desired result, a zinc smeltery was erected in Alberta, but proved unsuccessful. This failure was not altogether due to the character of the ores treated, but was due to inherent defects in the plant, introduced by the designer in an endeavour to improve upon the Belgian model. Prior to the erection of this plant, Mr. F. T. Snyder obtained a patent for an electric process and a furnace designed to treat these zinc ores. The first electric furnace was erected in Vancouver, but proved unsuccessful. The matter was not allowed to drop, however, for with commendable pertinacity a furnace of new design was erected in Nelson, B.C., and the experiments recommenced, but, up to the present time, they have been without success. While the parties interested in these experiments deserve much praise for their perseverance in trying to overcome a real difficulty, consuming valuable time and costing much money, it is to be regretted that the parties interested did not, first of all, investigate the electric process invented by Dr. de Laval, which has been in operation for some years in Trölhatten, Sweden. The only proper course in experimentation, the only one likely to lead to success, requires that information be obtained not by reading patents, but by investigation and actual observation on the spot of all that has been accomplished in the direction in which improvement is sought to be introduced.

There are, at present, four processes invented in Europe for the production of metallic zinc or zinc oxide from complex zinc ores, which promise economic results:

(1) The De Laval process, in operation at Tröllhatten, Sweden, already mentioned;
(2) The improved De Laval process, a demonstration plant for the operation of which is being erected in London, England;
(3) The Côte-Pierron process, invented in France, and
(4) The bisulphite process. A demonstration plant to operate this process is being erected in Wales, Great Britain.

The first three systems are electric smelting processes; the last is a wet chemical process with a final product of zinc oxide.

Arrangements have been made by the Department of Mines for the investigation of these processes in the interests of the zinc miners of British Columbia.

If any one of the first three processes proves successful and can be introduced in Canada, the interests of economy will be served in a double sense: (1) because the electric process saves fuel, and (2) because the exportation of raw material and reimportation of finished product increases its ultimate cost. This unnecessary expense would also be saved.

Nickel—Whenever we speak of our mineral wealth we grow eloquent in describing our vast nickel resources, and we may well be proud of possessing the deposits of the Sudbury region. But really, of what particular and special benefit are these deposits to our country? We mine the ore, smelt it into matte and send it as such out of the country. If we want nickel or nickel steel we have to import it. The employment of an inconsiderable number of men is all we get out of these splendid deposits. Not alone are they of little material benefit to the country, as at present exploited, but the method practised is exceedingly wasteful. Anyone who has been in that region and examined the method of heap-roasting employed must have been struck with the wastefulness of this method. Part of the oxides of copper and nickel of the ore are, during roasting, converted into sulphates, and when rain falls some of these valuable contents are leached out . I have seen large pools, greenish-blue with dissolved sulphate of copper and nickel, which finds its way into the soil and is lost; while the valuable sulphur dioxide destroys all vegetation in the vicinity. In addition to these losses, the iron contained in the ore is slagged off and lost also.

A more rational process, saving all the contents, would be crushing and concentration of the iron and magnetic nickel contents by magnetic separation. The tailings would contain the copper, non-magnetic nickel compounds and all the precious metals contained in the ore. Roast the iron concentrates; save the sulphur dioxide as sulphuric acid; smelt the roasted nickeliferous pyrrhotite into nickel pig in the electric furnace; treat the tailings after roasting by the electrolytic method as it is practised at present in dealing with the matte; convert the nickel pig into nickel steel in the electric furnace; dilute with pig iron, if necessary, to bring the nickel content down to the required percentage, and add nickel, if required, to raise it.

Experiments are now being conducted for the Mines Branch to determine how much of the nickel remains in the concentrates and how much passes into tailings.

The introduction of such a process, which would treat tailings containing the copper and part of the nickel by the electrolytic process in operation at Fredericktown, Missouri, U.S.A., and patented by Mr. N. V. Hybinette, would be in the interests of economy. A refinery established in the Sudbury region on the plan outlined, would enable Canada to export finished products instead of the matte, as is now done.

Cobalt-Silver Ores—In the case of our Cobalt-Silver ores, the miners receive little more than the values of the silver contents in the high grade ore (small allowances are made on cobalt over 60%), and only a percentage of the silver contents in the low grade ore.

All low grade ore is shipped to the United States, where it is used as a silicious flux in the large lead smelters. The lead acts as a collector of the silver, and the cobalt and nickel is slagged off. It is impossible to treat economically the low grade ore in Canada, on account of the absence of large lead smelters in the vicinity of Cobalt.

The mine owners at Cobalt are handicapped by the following conditions:—

1. The smelters being situated some distance from the mines, high freight rates are charged by the railways for the transportation of the ore from the mines to the smelters.

2. The freight rate on coal is high. Coal costs $6.00 per ton at Cobalt. Of this, $3.25 represents freight rates from Black Rock to Cobalt, a distance of 448 miles. The *cost of the coal,* with *freight rates* from Pittsburg to Black Rock, a distance of 270 miles, is $2.25 per ton. This shows that the freight rates from Black Rock to Cobalt are disproportionately high.

3. Small payments are made for the cobalt contents of the ore, on account of the limited demand for that mineral.

4. The arsenic is of little value after being refined, on account of its being produced some distance from the market (the market is east of Chicago in the United States), and the United States railways give a very much lower rate on arsenic produced in the Western states than the rates obtainable in Canada. Arsenic shipped from Canada is charged a fourth-class rate, while arsenic from Utah and Montana is charged 83.33% of the sixth-class rate. The latter rate is about one-half of the former.

I might say in this connection, that, if the miner approached the Dominion Government and asked for assistance, much might be done to solve these difficulties and to help the mining industry in general. It would be of great benefit to Canada if the government would install a fully equipped metallurgical and ore-dressing plant, by means of which new methods could be devised for a more economical treatment of our ores. Each ore is practically a study in itself, and much money is lost annually by the installation of unsuitable plants, and by the necessary change in equipment brought about by the experience gained by the company after operating for a time. This could be avoided by having the government do the primary experimenting.

In the case of complex ores, much could be done towards the economical saving of two or more of the valuable minerals present.

I do not think that there would be any doubt but that the mine owners, as a matter of business, would utilize the methods devised by such a department after they had been shown to be successful.

Peat—In the central provinces of Canada the high price of imported coal, on the one hand, and the depletion of our forests, on the other, with consequent rise in the value of wood, due to its increasing scarcity for constructional purposes, together with the possible suffering which would be entailed in the event of the supply of coal being diminished, or even cut off, by a coal strike, or some other cause, in the United States, makes the question of substituting peat for imported coal one of supreme importance.

The cost in Winnipeg of the poorest quality of wood (spruce and tamarack) is from $6.00 to $8.00 a cord; while coal is $10.50 a ton. In Ontario, Quebec and

New Brunswick, wood and coal are somewhat cheaper, but still too dear for both domestic use and economic manufacturing purposes. And considering the fact that we imported, during the year 1908, coal to the value of $28,500,000, constituting an enormous and increasing drain on the wealth of the country, every effort should be made to retain a portion of this money at home, not only to give employment to our own people, but also to lessen our dependence upon outside sources. This much-desired economy may be largely effected by the establishment of a peat industry on a sound basis.

It has been estimated that the known peat bogs of Canada cover approximately an extent of 36,000 square miles. This area would produce about twenty-eight billion tons of air-dried peat, which would be equal in fuel value to about fourteen billion tons of coal. The comparative fuel value of peat, coal and wood is: 1 ton of the best coal is equal to 1.8 tons of peat or 2.5 tons of wood.

The attempts made so far in Canada to manufacture a commercial peat fuel have been failures, and very little peat-fuel is at present available. The chief cause of most of these failures has been in the ignorance of the nature of peat on the part of those who have engaged in the production of peat-fuel. In several instances the bogs chosen for the work have been unsuitable for the purpose in view. A proper investigation of the bog previous to the commencement of operations was seldom made; consequently, methods entirely unsuitable for the utilization of the bog in question have been employed, and the result has been failure. These failures, involving as they did considerable loss of capital, have created a profound distrust of everything connected with peat and the utilization of peat bogs, with the result that, at the present time, the peat industry in Canada is practically dead. With a view to assisting Canadian manufacturers of peat products, a member of my staff was commissioned to proceed to Europe to investigate and report upon the peat industry in those countries in which it is in successful operation. Armed with the practical knowledge thus gained, the Mines Branch is attacking the peat problem in this country, and a systematic investigation of the Canadian bogs has already been started with a view to ascertaining the quantity and quality of peat contained in them.

Up to date about twelve bogs have been examined, mapped and reported upon. Any person desiring to start a peat plant can, upon application, have his bog investigated, and it is hoped that such failures as have been due to the choosing of bogs unsuitable for the purpose to which the product was to be applied, will, in future, be avoided.

Another object of this investigation is to protect the public, as far as possible, by preventing the expenditure of capital in the exploitation of worthless bogs.

It was conceived that the most practical manner in which to awaken public interest in the utilization of our peat resources would be the establishment of an experimental plant where peat-fuel could be manufactured on a commercial scale and by methods which have already proved successful in European practice. At such a plant, interested parties would have an opportunity of ascertaining for themselves the working of the bog, as well as the suitability of the peat-fuel produced.

With this object in view, the Government has acquired a peat bog of 300 acres, located at Alfred, near Caledonia Springs, Ontario, having an average depth of eight feet. Actual work was begun during last summer in surveying, levelling and draining the bog. About five miles of ditches have been dug; a storage shed to hold 300 tons of air-dried peat, a blacksmith's shop and an office have been built, and the necessary tracks and auxiliary machinery for supplying the Anrep peat machine have been installed. It is the intention to begin work in the manufacture of peat at the end of next April.

The recent improvement in gas producers and gas engines has opened up

a new field for the use of peat and lignite. It is a well established fact that the most efficient steam plant utilizes only about 15% of the calorific value of the fuel, while a gas producer-plant utilizes about 18 to 22%. The saving in fuel effected by the gas producer has not, hitherto, been duly appreciated in Canada. A power plant located at the peat bog and using producer gas derived from peat can furnish electric energy which may be transmitted to the market in the same way as electric energy generated by water-power.

A Government fuel-testing station has already been built in Ottawa by the Department of Mines, with the object of testing the efficiency of the various classes of fossil fuel and to determine their adaptability for the different uses to which fuel is applied.

The first use to be made of this plant will be to demonstrate that peat containing up to 35% of moisture may be economically employed in a producer to furnish power gas for gas engines.

The machinery which is being installed consists of a gas producer and a 50 H.P. gas engine of the Körting type, a dynamo of 50 H.P. capacity, and a wire rheostat to absorb the power developed. About 70 tons of air-dried peat are in the shed adjacent to the power plant. It is expected that the plant will be in working order by the end of February next, when interested parties may inspect the plant and inform themselves with regard to its operation, efficiency and the cost of the power produced.

Many applications have already been received from parties desirous of visiting the power plant at Ottawa and the peat plant at Alfred.

The trnsportation to great distances of low grade fuel such as air-dried peat, is not recommended, either for domestic or power purposes. But, inasmuch as the expense for the erection of a peat plant of 30 tons daily capacity would not exceed $7,000, and, since workable peat bogs are scattered throughout the farming regions of Ontario and Quebec, the most economical plan for utilizing this fuel would be the erection of a number of plants at strategic points, to be operated in the interests of the neighbouring communities.

Further, peat-fuel is not only a valuable asset as a substitute for coal, but those classes of peat which are practically useless for fuel are extensively utilized by European farmers as moss litter. In fact, the manufacture of this litter and its by-product, "peat mull," has become a well-established industry in Sweden, Germany and Holland.

Peat mull, obtained as a by-product in the manufacture of moss litter, is an excellent material for packing fruit and plants and for storage and shipping. Its antiseptic properties and great affinity for moisture render it invaluable as a preventive of decay in fruit.

In Norway some 200, and in Sweden between 300 and 400, small plants are manufacturing this material; while in Germany and Holland, where there are a number of large plants, the manufacture of moss litter has become a flourishing industry. Most of the smaller plants are owned by groups of farmers, who work the bogs themselves.

Inasmuch as moss litter is, in many cases, a by-product in the making of peat fuel, its exploitation would materially reduce the cost of manufacturing peat-fuel if placed on the market commercially in conjunction with peat mull. Several shipments of moss litter from Holland have been made to the United States—at $16.00 per ton.

The different Departments of Agriculture in European countries very strongly urge farmers to use moss litter. Seeing that Canada is fast becoming an important fruit exporting country, it is evident that the use of peat mull as a packing material would be a great economic advantage.

Before passing finally to the important question of coal mining, I would conclude my plea for the economical exploitation of our abundant peat-fuel

resources, the importance of which cannot be over-estimated, by warning my hearers that the introduction of a fuel like peat is an undertaking that cannot be accomplished in a year or two, but will require an aggressive educational campaign in order to demonstrate the value of the products as well as the manner of manufacture.

Coal—In England and Germany every effort is made to prolong the life of the coal mines by the adoption of mining methods which insure a more complete extraction of the coal than do the methods practised in the United States and Canada.

The system employed in England is known as the longwall method.* By this method practically the entire coal in a seam is extracted, leaving behind no pillars and barriers; only the coal of pillars and barriers in the air and passage ways is left behind and sacrificed. The percentage of available coal left in these pillars and barriers is about 2.8%; the amount lost through faults and bad coal, 3%; making a total of irrecoverable coal equal to, say, 6%. Although, by the use of this method, the actual cost of extraction per ton of coal is increased, the productive life of the mine is greatly prolonged.

The method employed in the United States is less expensive and permits the extraction of the largest tonnage at the lowest possible cost, irrespective of the loss of life entailed, or the amount of coal left behind. This affirmation applies also to the methods of coal mining practised in Canada. By this system—the room-and-pillar method—only 50% of the original coal is extracted, leaving 50% to be taken out afterwards by the removal of pillars, which is a dangerous operation and which, both in quality and quantity, entails great loss of coal, amounting, at least, to 15% and sometimes double this figure. If the companies operating the coal mines of North America were forced to pay compensation for loss of life and accidents, as under the English law, they would have incurred an expenditure of $7,656,000 during 1908.† If this amount of money had been expended in more economic and safer methods of mining, the number of lives lost would have been greatly decreased and the available fuel supply greatly increased.

But while the conservation of coal by economic methods of mining is of great national importance, the conservation of human life is of still greater importance. The lamentable loss of life and the occurence of accidents in our coal and metalliferous mines reflects seriously upon mining conditions in Canada.

In England the average loss of life per 1,000 men employed during the years 1903 to 1907 was

Coal mines	1.29
Metalliferous mines	1.08

* "Our investigations and recommendations relate primarily to questions of safety in mining, but in this connection we have been greatly impressed with another closely associated phase of the industry, viz.: the *large and permanent loss of coal* in mining operations in many portions of the United States.

This is a *serious, permanent,* and *national* loss. It seems to be a natural outcome of the ease with which coal has been mined in the United States, and the enormously rapid growth of the industry.

The active competition among the operators and the constant resulting effort to produce cheaper coal has often naturally led to the mining of only that part of the coal which could be brought to the surface most easily and cheaply, leaving underground, in such condition as to be *permanently lost,* a considerable percentage of the total possible product.

Certainly, much of this loss can be prevented through the introduction of more efficient mining methods, such as the *Longwall* system, more or less modified, and the flushing method." Extract from report of "Foreign Experts" to the United States Government.

† See report by Frederick L. Hoffman, statistician of the Prudential Insurance Company of America, Newark, New Jersey.

Contrast with this the average men employed in Canada, per 1,000, for the ten years, 1899-1908:—

British Columbia: coal mines	9.21
Nova Scotia: coal mines	2.67
British Columbia, 1908: metalliferous mines	5.93
Ontario, 1907: copper and nickel	2.19
silver and iron	7.36

The actual death rate per 1,000 men employed at Cobalt in 1908 is difficult to obtain, on account of many mines not sending in returns of the number of men employed, but it is safe to say that the death rate was about 12 per 1,000 men employed underground, 36.6 per cent. of which was due to explosives.

If, therefore, stringent laws have been enacted for the protection of even the low type of labour employed in the South African mines, surely Canada should lose no time in giving its sanction to a code of laws and regulations that will effectually conserve and preserve the valuable lives of its citizens. Canada at the present time, is without such laws and, in this respect, stands unique, for in every other mining country, laws relating to explosives have been enacted. Legislation on these lines would manifestly be in the direction of the highest economy.

Such is a brief generalized view of some of the possible economies in the production of the mineral resources of Canada. I have set forth the economic advantages to be gained (1) by the adoption of the electric furnace in the smelting of our immense deposits of refractory iron ores; (2) by the introduction of more effective metallurgical processes for the treatment of zinc, nickel, and silver-cobalt ores; (3) by the utilization of peat and lignite as substitutes for coal fuel, especially in gas producers; (4) by the manufacture of peat by products into moss litter and peat mull, in the interests of farmers and fruit growers; (5) by the adoption of the longwall system in coal mining in order to avoid unnecessary waste; and finally, in the conservation and safeguarding of human life by the adoption of a stringent code of laws regulating the use of explosives.

When these economies have been translated into actual fact, doing away with wastefulness on the one hand, and conserving our national resources on the other: when we shall have succeeded in sending out to the foreign markets finished products instead of raw material, as at present, then, not only will the industrial progress of the country be accelerated, but Canada will have taken its place among the great commercial and industrial nations of the world.

Hon. Frank Cochrane, Minister of Lands, Forests and Mines of the province of Ontario, prepared an address on the natural resources of that Province, but, on account of being called away, was unable to read it. The address, however, was secured in written form, and is as follows:—

THE CONSERVATION OF THE NATURAL RESOURCES OF ONTARIO.

The natural resources of Ontario under the control of the Department of Lands, Forests and Mines are lands, timber, water-powers, mines and minerals. The conservation of the natural resources of Ontario may be said to consist of preserving them from destruction or waste and disposing of them as public necessities may require, subject to such conditions as will, as far as possible, prevent monopoly and ensure their economical development.

Lands—The total area of the Province of Ontario, exclusive of the great lakes, is estimated at 140,000,000 acres. Of this, there is surveyed, 46,000,000 acres, leaving an area unsurveyed, of 94,000,000 acres. There has been alienated by sales, locations, etc., 24,000,000 acres, leaving still in the Crown, 116,000,000 acres. Of this, 20,000,000 acres are known to be valuable agricultural lands.

Having seen the folly of opening for settlement, townships that are rough and which contain only a small percentage of good land, the Government of Ontario has provided that, before a township is opened for settlement, it must be inspected by a competent officer to ascertain: (a) the percentage of good land in it; (b) the quantities and varieties of timber; (c) whether it is chiefly valuable for its mines and minerals. If the inspection shows it to contain less than 40 per cent. of good land, the policy of the Government is to keep it closed from settlement for the growing of timber, or, if it has large quantities of pine, to keep it closed until the pine timber has been removed, or, if it is valuable chiefly for its mines and minerals, to exclude all settlement.

In the same connection, we found that, in townships already opened, people took up rough lands for the purpose of obtaining possession of the timber, under the cloak of farming. By this practice, lands were withdrawn from the operation of timber license, so far as timber other than pine was concerned, to the injury of the licensee, and without benefit to the Crown.

We have now instituted the practice of inspecting all lands applied for, and if the inspection shows less than 50 per cent. of agricultural land in the area desired to be located, we do not grant the application, but leave the land in forest. Our desire is, and we are carrying it out to the best of our ability, to keep the lands of the Crown for the use for which they are best adapted.

Timber—Secondly, as to timber. The Government has recognized that the pine timber is one of our most valuable assets, and wherever we have found large bodies of pine we have withdrawn the territory from settlement and put it into what we call "forest reserves," where no settlement is allowed.

The reserves already set apart in Ontario are:

Timagami Forest Reserve	containing	5,900	sq. miles.
Mississagi Forest Reserve	"	3,000	" "
Nipigon Forest Reserve	"	7,300	" "
Eastern Forest Reserve	"	100	" "
Quetico Forest Reserve	"	1,560	" "
Sibley Forest Reserve	"	70	" "
Algonquin National Park	"	1,930	" "
Total		19,860	sq. miles.

In each of these reserves there is a chief ranger with a staff of fire rangers under him. These rangers are assigned certain beats which they have to patrol. They are supplied with poster copies of the "Fire Act," printed on cotton, to be put up on portages, etc., and also with pamphlet copies of the Act to be handed to individuals whom they meet, so that no one shall be able to say he does not know the law. In addition to this, these rangers caution parties of the necessity for care in the use of fire and of extinguishing it when they are leaving the locality.

When mining prospecting is going on, as in the Timagami Reserve, prospectors must obtain a permit from the Department, giving them permission to

explore in the Reserve, and they must produce the same when called upon to do so by the park ranger.

We do not sell any timber in these reserves except where it is damaged by fire. Of course, in the Timagami Reserve there is the Booth pulpwood concession, which covers spruce and jack-pine, and, in the Algonquin Park, part of the territory is under license for all kinds of timber and part for pine only.

It is estimated that there is on these Reserves about nine billion feet of pine, which is worth now about $90,000,000. We had 202 men on duty in them as rangers last year, and we spent for fire ranging purposes about $76,000.

Then there is an area of about 20,000 miles subject to license. On this area we have a staff of fire rangers. Recognizing that the licensees are the people best qualified to select the ranging staff on their limits, we have accepted their nominations—subject to the right of removing the rangers for incapacity or improper conduct—and appointed the men they desired as fire rangers. These rangers, in the same way as those in the reserves, are furnished with copies of the "Fire Act" to post up in public places and on portages, shanties, etc., and also pamphlet copies to hand to all parties with whom they come in contact, such as tourists, surveyors, prospectors, settlers, lumbermen, etc. The area is divided up into districts, and, in each district, there is a supervising ranger, who has charge of the staff in that district and is responsible for seeing that they are on duty and properly performing the work for which they are appointed. Where the licensees do not apply to have rangers put upon their limits, the Department selects the ranger, puts him on and makes the licensee pay his proportion of the expense.

One-half of the cost of the wages and expenses of fire ranging is borne by the licensee and the other half by the Department. This system was inaugurated in 1885 and has grown from year to year, and one effect of it has been to enlist the sympathies of those who have an interest in the protection of the forest, such as lumbermen, settlers, explorers, etc. An additional advantage is this, that if a fire does take place, the rangers are able to report to their employers its locality and the quantity of timber damaged, so that the timber can be cut before it goes to waste. We had on duty on licensed land last year 450 rangers at a cost to the Crown of about $60,000.

Recognizing the great danger to the forest incident to railway construction, the Minister of Lands, Forests and Mines was empowered by the Legislature to place fire rangers along the lines of railways traversing the back country, and to charge the expense to the railway companies.

This has been carried out wherever it is considered there is danger to the forest, such as along the Canadian Pacific Railway, Canadian Northern Railway, Transcontinental Railway and the Timiskaming & Northern Ontario Railway. We had on these railways, last season, 175 rangers, at a cost of about $73,000.

In addition to the rangers on the forest reserves and along the lines of railways, we had, in exposed regions, along certain of the larger rivers that are used as highways, fire rangers who pursued the same course in warning parties with whom they came in contact, supplying them with copies of the law and impressing upon them the necessity for care in the use of fire.

Along the line of the Transcontinental Railway, extending from the eastern to the western boundaries of the Province, are enormous quantities of wood suitable for making pulp and paper. In this region there is estimated to be about 300,000,000 cords of this wood. The Transcontinental, in its course, crosses the following large streams:—

	Length.
Abitibi river	250 miles.
Frederick House river	120 "
Mattagami river	250 "
Kakozhisk river	200 "
Kapuskasi river	200 "
Opazatika river	125 "
Missinaibi river	250 "
Kabinakagami river	150 "
Kenogami river	250 "

besides other smaller streams.

The pulpwood in this region will float down these streams to the crossing of the railway and will there be manufactured into either pulp or paper. The construction of the railway has necessitated the placing of a considerable staff of fire rangers in that region, but, as the construction is extended, as it is likely soon to be, a large additional number of fire rangers will have to be placed along it, and the timber in this region will be in great danger, as the foreign labour employed in railway construction is ignorant of the law and careless in the use of fire. We have an asset in our timber, pulpwood, etc., which is valued at between three and four hundred millions of dollars, and we would be grossly neglectful of our duty if we did not use every effort to conserve it.

Recognizing that the people of the Province are entitled to the benefit of the labour incident to the using up of their natural resources, we have provided that all pine saw-logs, spruce pulpwood and hemlock must be manufactured in the Dominion, into lumber, pulp or paper. The effect of this has been to increase the demand for labour and give a market for all kinds of supplies used for lumbering purposes.

Waters—The protection of the flow of our rivers is a question of great importance, and this was one of the objects kept in view in the setting aside of parks and forest reserves.

In the Algonquin Park the head-waters of the following important rivers are to be found: Petawawa, Madawaska, Muskoka, Amable du Fond, South and Maganetawan.

In the Timigami Forest Reserve are to be found the head-waters of the Montreal, Matabitchuan, Timagami, Sturgeon, Vermilion, Wanapitei, Onaping and other tributaries of the Spanish, the Frederick House and the Mattagami.

In the Mississagi Forest Reserve are the Mississagi river and its tributaries, the Wenebegon, White and Sauble and branches of the Spanish.

In the Nipigon Reserve are the Nipigon river—the largest stream flowing into Lake Superior—the Black Sturgeon, Gull, Poshkokagan, Pikitigushi, Onaman, Mamewaminikan, Sturgeon and Wabinosh.

In the Quetico Reserve are the head-waters of the Rainy and its branches, the Maligne, Quetico and Sturgeon.

All of these rivers are large and important streams, and the protection of their head-waters is a matter of great public importance and a valuable conservation of natural resources.

Previous to 1898, no reservation of water-powers was made in grants of land by the Crown. If a water-power was situated on a lot or location, and the bed of the river—the actual site of the power—was included in the area of the lot, possession passed to the grantee. In 1898, however, the Legislature of Ontario passed an Act providing for the reservation of water-powers and for the making of regulations regarding their disposal, by the Lieutenant-Governor-in-Council. These regulations provided that all water-powers having a natural

capacity at the low-water stage of more than 150 H.P. should not pass with the land, but should be leased, together with a sufficient area adjoining the fall, for its proper development. The lease provided:—

(1) For the payment of an annual rental to the Crown.
(2) For the development of a specified quantity of power within a given time.
(3) For the supplying of surplus power by the lessees to others requiring it.
(4) For the regulation by the Lieutenant-Governor-in-Council of the rates and conditions upon which such surplus power should be supplied.
(5 For the development by the lessees of the full capacity of the power if there were a *bona fide* demand for it, of which demand the Lieutenant-Governor-in-Council should be the judge.

In 1907, these regulations were extended and the form of lease improved, the Hydro-Electric Power Commission being constituted the agent of the Government in dealing with water-powers subsequent to their lease by the Crown.

Under the Act of 1898 and the Regulations pertaining thereto, some twenty water-powers, providing for a minimum development of 26,600 H.P. and a maximum of 53,700 H.P. have been leased. The annual revenue accruing to the Government from these leases is $12,000. Large investments, amounting to several millions of dollars, have been made by the lessees in dams, improvements, and machinery for the development and utilization of these powers.

There can be no doubt that the use of water-power will become more and more general, especially as mineral fuel tends to become dearer and scarcer. The possession of an effective measure of control in the public interest over the water-powers of the Province, is most important. Briefly, the policy of the Government in dealing with this item of the natural resources is to obtain a fair revenue for the public chest, while at the same time encouraging the development and utilization of these powers and guarding against their being monopolized or being held merely for speculative purposes.

The above has reference to water-powers other than the Niagara falls, which has been dealt with in a special way by the Queen Victoria Niagara Falls Park Commission, subject to approval of the Legislature.

Minerals—The application of a policy of conservation to minerals is somewhat more difficult than to water-powers. Minerals lying undiscovered and dormant in the earth's crust are, for all practical purposes, non-existent. Only when they are found and brought to the surface, can they be made subservient to the uses of man. The mechanical and industrial necessities of civilization require a constant and ever-increasing supply of the useful minerals, and it seems difficult, if not impracticable and useless, to put any check upon the production of such commodities as gold, silver, iron, lead, copper, etc. The demand for these primal necessities in the arts and industries of the world is not only urgent but imperative, and the demand must be supplied if the present complex civilization is to remain in existence and develop in the future as it has done in the past.

It must be recognized that the business of mining and extracting minerals is, so far as the deposits themselves are concerned, a destructive industry. A body of ore, no matter how large it may be, is strictly limited in quantity, and when it is taken out of the ground it cannot be restored or replaced or reproduced.

There are some mineral substances exceedingly valuable in their nature which, however, lend themselves more readily to conservation than do the metals. This remark is particularly applicable to the fuels—coal, petroleum, natural gas, peat.

Ontario is practically the only province in the Dominion which produces petroleum. Natural gas is found also in Alberta, as well as in this Province. The requirements of the home market are not now met by the domestic production of crude oil in Ontario, for a quantity equal to the home production is annually imported for refining purposes, and this, notwithstanding the bounty of 1½ cents per gallon paid by the Dominion Government on domestic crude. The production of petroleum in Ontario is, at present, declining, but there is good reason for believing that other sources of supply may be discovered at any time, since the formations in which the present fields exist are widespread in southern Ontario. On the northern slope of the height-of-land there is a large area of rocks similar in age and character to those in the southwestern peninsula, and it is reasonable to suppose they will be found to contain the same mineral substances, namely, petroleum, natural gas, salt, etc.

Natural gas is a fuel which has many advantages. It is cheap, efficient and clean, gives no smoke, leaves no ashes, can be turned on and off at will. The production of natural gas in this Province is annually and rapidly increasing. In 1907, the value at the wells, at a low rate of valuation, was three-quarters of a million dollars; in 1908, almost a million. In the production of natural gas, and especially in the opening up of new fields, there has, in the past, been enormous and shameful waste. In the United States, gas wells have been allowed to blow off into the air millions of dollars' worth of gas, or have been lighted and allowed to burn night and day for weeks and months. There have been similar scenes in our province. Steps have been taken by the present administration of Ontario to check such wanton extravagance. A tax of two cents per thousand feet has been levied on natural gas, with a rebate of 90 per cent., when the gas is used in Canada. A gas well giving off a million cubic feet of gas per day is not a very large well, but if the owner allows the gas to escape, he is presented with a bill of $20 per day for every day of waste. Very few wish to indulge in the privilege of wasting gas and pay $20 a day for the pleasure. The result has been that, since the Act was passed in 1907, there has been an almost entire stoppage of waste of gas in the gas fields of Ontario.

A further step in the direction of economizing this valuable fuel would be to restrict its use, if possible, to domestic purposes only. Large quantities are now used in generating steam and in the coarser industries, such as burning lime and making brick. At least fifty thousand people are enjoying the advantages of natural gas in Ontario to-day, and, if it could be confined to household purposes only, they might continue to enjoy its advantages for very many years. At present, the outlook is for a much earlier exhaustion.

If natural resources, including minerals, cannot be withheld from the urgent requirements of the present generation, to serve the necessities of posterity, they can, at least, while being utilized, be made to yield a revenue for the public good. Accordingly, the Legislature in 1907, imposed a tax of 3 per cent. on the net profits of mining companies when such profits were in excess of $10,000 per annum. All legitimate expenses, depreciation, etc., are allowed for, and the percentage computed only on actual profits. During the three years this Act has been in operation the amount received from this source has been $156,900.

The Hon. Adam Beck, M.P.P., Chairman of the Hydro-Electric Power Commission of Ontario was then requested by the Chairman to read a paper on

SESSIONAL PAPER No. 52

THE CONSERVATION OF THE WATER-POWERS OF ONTARIO.

MR. BECK said:

I count it an honour and a privilege to address the Commission for the Conservation of Natural Resources. I do not think I will err in ascribing your generous invitation to the fact that I have been associated in my own Province, the province of Ontario, with the effort which has been in progress there for some years back to conserve, as far as possible, but with due regard to its vested interests, the valuable water-powers of that Province.

The object lesson which the policy of the Government of the Province of Ontario has furnished in the conservation of natural resources has attracted considerable attention throughout the world, and it is, perhaps, fitting that, at the beginning of the career of the National Commission, whose duties are of the highest and most responsible character, I should endeavour to set forth, in some brief but orderly fashion, the basis and progress of a similar movement, on a smaller scale, in my own Province.

I will ask you, therefore, to accompany me in thought while I sketch, as briefly and clearly as the character of my subject permits,

(1) The antecedents and origin of the Hydro-Electric Power Commission over which I have the honour to preside;
(2) The scope of the legislation creating the Commission;
(3) The scope, progress and value of the undertaking with which the Commission is charged;
(4) The effect upon vested interests of the work of the Commission; and
(5) The probable future of the Commission.

I.—Antecendents and Origin of Power Commission—The Hydro-Electric Power Commission of Ontario was born of a wide-spread public demand that steps should be taken by the Province to preserve and develop the people's rights in the provincial water-powers, and to protect them from the baneful effects of monopoly prices. The harnessing of Niagara Falls had been the dream of engineers for a long time. Like other dreams of the leaders of thought and progress among the people, on questions of national import, it interested the public by slow degrees. The various efforts that were made from time to time to form companies for the generation of electric power at the Falls stimulated interest, and when, at last, the manufacture of electrical transmission apparatus had sufficiently advanced to permit of the commencement of large hydro-electric installations, the economic possibilities of the Falls took a stronger hold upon the public mind. The value of cheap electric power to a province dependent upon the coal-fields of Pennsylvania and its trusts was, and is, sufficiently obvious.

One of the first definite expressions of public interest in the question occurred in the spring of 1900, when the Toronto Board of Trade appointed a committee to investigate and report upon the power question. The committee, which was presided over by the late Mr. W. E. H. Massey, reported that the manufacturers' hope for cheap power in the south-western portion of the Province depended for realization upon the utilization of the resources of Niagara falls. The report of this committee was followed by increasing public interest, and, in the early part of 1902, voluntary meetings were held in many cities of the Province, which, together with the support of the Canadian Manufacturers' Association and of numerous Boards of Trade, served to rivet public attention on the matter.

A meeting of manufacturers was held at Berlin in June, 1902, at which representatives from Toronto, Galt, Guelph, London, and a number of other centres were present, the object being that of discussing and furthering the best method of securing electric power for manufacturing and other purposes from Niagara falls. Early in 1903, the city of Toronto made application to the Legislature for authority to generate and transmit Niagara Falls power for the users of the city. The application, however, was refused.

To pass rapidly over intervening events, it is sufficient to say that, as a result of the decisions of, and action initiated by, the aforementioned and subsequent meetings of manufacturers and municipal representatives, an Act was passed by the Ontario Legislature the following year (1903) which authorized Ontario municipalities to appoint a Commission to inquire into the desirability of securing the establishment and operaton of municipal light, heat and power works and to establish the same. Immediately after the passage of the Act in question the municipalities of Toronto, London, Brantford, Stratford, Woodstock, Ingersoll and Guelph exercised their powers and appointed a Commission to inquire into the best method of developing power for their needs and to estimate the cost thereof. The Commission was composed of Mr. E. W. B. Snyder, of St. Jacobs, Mr. P. W. Ellis, of Toronto, Mr. W. F. Cockshutt, of Brantford, Mr. R. A. Fessenden, a Canadian electrical engineer then residing in Washington, D.C., and myself. Mr. Snyder was appointed Chairman of the Commission, and Messrs. Ross and Holgate, of Montreal, the well-known and highly capable firm of electrical and hydraulic engineers, were appointed by the Commission to investigate and report upon the engineering aspects of the whole matter. Incidentally, it may be observed that the Commissioners served from a sense of public duty, neither seeking nor accepting any remuneration for their services.

The report of this Commission was issued on the 28th of March, 1906, and, by general consent, it set forth, for the first time, an authoritative and exhaustive exposition of the whole question of the commercial value to the province of Ontario of its great natural water-powers, when utilized for the generation and transmission of electric power. It contained, among other things, a reliable estimate of the power consumption of the district embraced, the cost thereof when produced from coal and steam, the capital and operating costs of a large generating plant at Niagara Falls combined with the necessary transmission lines throughout the district in question, and the enormous financial savings and economic stimulus that would result from the carrying out of such a plan of generation and transmission as was therein recommended.

It became evident during the later stages of the work of this Commission, and also in the discussions which followed the publication and distribution of the report among the municipalities, that certain serious difficulties of procedure were inherent in any plan which depended for its final accomplishment upon purely municipal initiative. The Government of the, then, Hon. Mr. Whitney, which, in the meantime, had been formed, recognizing these difficulties, appointed, partly in obedience to the public opinion of the time, and partly from a spontaneous recognition of the importance of the water-power question, a new Commission to make still further inquiries. This Commission was composed of Mr. Geo. Pattinson, M.P.P., of Preston, Mr. P. W. Ellis, of Toronto, and myself. Subsequently Mr. Ellis retired because of ill-health, and Mr. John Milne, of Hamilton, took his place.

Further investigations were made into the location and value of the provincial water-powers by this Commission, the effect of which was to add greatly to the general fund of reliable information on the subject. As a final result of all the inquiries, reports, discussions and public agitation, the Hydro-Electric Power Commission of Ontario was, in obedience to, and with the full force and sanction

of, an overwhelming body of public opinion, formally created by statute on the 14th of May, 1906, its powers, however, being revised and amplified by a subsequent Act passed on the 20th of April, 1907. This Commission was originally composed of the Hon. J. S. Hendrie, of Hamilton, Mr. C. B. Smith and myself. Subsequently, Mr. Smith resigned, and Mr. W. K. McNaught, of Toronto, was appointed in his place. To the Commission thus constituted, with Mr. P. W. Sothman as chief engineer, has been confided the task of carrying out the great scheme which I shall presently describe more fully.

It will be observed from this brief and rapid outline sketch that the Hydro-Electric Power Commission—whether it be, as is so often represented, on the one hand a priest and prophet of evil, or, on the other hand, as less frequently represented, but perhaps more deeply felt, a great and potent agency for the public good—does not represent a policy which is the sole and exclusive creation of any single man or Government, but rather a policy which embodies the judgment of an intelligently instructed public opinion, the cumulative force of which made itself felt through all the organs of the public voice upon the general mass of men without distinction of party.

I ought, however, before leaving this branch of my subject, to note that the great potentialities of Niagara falls as a power reservoir had, at an earlier stage, fastened themselves upon the imagination of the Government of the Hon. G. W. Ross, which endeavoured by a system of regulation, to do something for the public welfare in regard thereto. The legislation of that Government, however, proved inadequate. It was intended, among other things, as between the companies then in existence, to protect the public interest by prohibiting amalgamations, pooling and the carrying out of arrangements to maintain or increase prices. Not only were the Government proposals incapable, by their very nature, of effective application, but they failed to make provision for the prevention of a system of sub-division of territory between the companies, which, whether ordered by nature or effected by arrangement between them, made the Electrical Development Co. and the Hamilton Cataract Power Co. the master monopolists of electric power in the Niagara peninsula.

I do not wish to be understood as endeavouring by these remarks to make any political capital out of this matter. Nothing is further from my thoughts. No government can safely and effectively prevent amalgamation taking place under some one or other of the variety of forms in which it may be incorporated, nor effectively prevent the making of arrangements designed to maintain certain price-levels when the parties thereto are few in number. There is no satisfactory and infallible method of proving "parole" or "gentlemen's" agreements, and therefore there is no satisfactory method of preventing or penalizing them.

II.—Powers of the Commission—The powers conferred by legislative authority upon the Commission may be broadly described as follows:—

It is duly authorized to investigate and report to the Lieutenant-Governor-in-Council upon any and all hydraulic, hydro-electric and other power undertakings, whether developed or undeveloped, throughout the Province; to inquire and report upon the Ontario branches of power undertakings originating outside, but bringing power within, the boundaries of the Province; to inquire and report upon the power and lighting needs of the Province in all its parts, and, upon the authority of the Lieutenant-Governor-in-Council, to purchase, lease, expropriate, construct or otherwise acquire generating, transmitting and distributing plants and works and to operate the same; to expropriate the power product of, or to contract with, any person, firm or corporation for a supply thereof; and to enter into all necessary arrangements with Ontario municipalities or

other corporations, including railway and distributing companies, for the fullest exercise of these powers, with the object of providing adequately for the supply of the power and lighting needs of the Province at the lowest possible cost. Authority is also given to the Commission to control the rates charged by municipalities upon the sale of power purchased from it, with the object of preventing excessive charges to the public or the veiled bonusing of favoured undertakings, and to the Lieutenant-Governor-in-Council to borrow on the credit of the Province all moneys required to carry on the various objects of the Commission.

It became necessary, however, during the legislative sessions of 1908 and 1909, to procure some auxiliary powers in order the better to proceed with the undertaking; and to secure the ratification of certain contracts, including some municipal contracts in regard to which systematic efforts were being made to prevent their completion, and to block and jeopardize thereby the whole undertaking.

These powers, thus briefly summarized, are wide and important, and cast upon the Commission a high degree of responsibility. Properly used, they will greatly develop the latent wealth of the Province and distribute its benefits among the mass of the people. The legislation has provoked much antagonism, and, in certain quarters, it has been strongly and persistently criticized as an improper exercise of legislative authority.

It has been contended that, in certain parts, it is *ultra vires* of the Legislature of Ontario; that, even though *intra vires*, it is, as a whole, indefensible from the standpoint of public morality, which calls for adequate protection of vested interests and sanctity of private contracts, and that, in any event, governments and their creature commissions are inherently incapable of operating business undertakings in a business-like way, and, therefore, from the economic point of view, it is unsound and involves the penalizing of the public in the very service it was designed to promote.

I am not concerned here to argue the constitutional question. That may be left to lawyers. It is improbable that the profession will become extinct or that the law courts will be closed in the immediate future through unanimity of legal judgment on this or any other constitutional question. Suffice it to say that we are advised the legislation is well within the rights of the Province, and, on that view, we are disposed to maintain it.

I would like, however, to consider shortly the moral aspect of the question. The essence of this criticism, which has been chiefly provoked by the building of a transmission line in the southwestern portion of the Province, touches two main points, viz., the right of the Government to employ public moneys in constructing and operating undertakings which may compete with those established by private enterprise, and the right of the Government to stay actions and to validate contracts. Now, on these questions, I would, first of all, point out that the Government of Ontario in authorizing the Commission to construct these electrical transmission lines, has, in reality, appointed the Commission an agent for certain municipal corporations, at their own request. The undertaking, which is in course of construction, is, for reasons of economy and expedition, being built, and will, on completion, be operated by the Commission on behalf of certain municipal corporations who will also pay for it. The Government is practically making a secured loan to the municipalities for the amount of the cost of the undertaking, which, with interest, is to be repaid by the municipalities, by annual instalments, within thirty years. Meantime, of course, the operating expenses are in the form of rentals, likewise payable by the municipalities. Neither the Commission nor the Government, as such, makes or accumulates one cent of profit or revenue out of the undertaking. It is wholly and only conducted for the benefit of the municipalities. I make this point clear in the

interest of clear thinking. It is a municipal enterprise conducted by the Commission at the request of, and as the appointed agent of, the municipalities, and at their cost and risk. It is not a direct Government undertaking organized and conducted on behalf of, or for the benefit of, the Government. In the second place, I would observe that, so far as my knowledge goes, the contention that governments are barred from employing public moneys for the furtherance of undertakings that may conceivably compete with those of private enterprise, has no such sacred sanction as its exponents pretend. I do not understand that any revelation has ever been made from Heaven to the effect that a democratic government commits the unpardonable sin when it assists in the estblishment of great and necessary public works for the well-being of the people, of whose interests it is the trustee.

I am not aware that the people of the Dominion of Canada violated any moral law in building the Intercolonial railway, or that the people or Government of the province of Ontario did so in building the Timiskaming railway. It is true that the history of the Intercolonial railway has not been a continuous history of increasing surpluses. I have heard it said thait there has sometimes been a deficit, and, of course, it may be contended that the deficit itself is an evidence of such violation. I do not think, however, that such reasoning will stand in any atmosphere except that of a political election. The best of men, as well as the best of projects, often meet loss in this world. The fact of the matter is, that theories of private property and of the limits of State interference are as plentiful as the generations and as varied as the schools of men, and it is grotesque that a single class of people should select that particular theory best suited to their exclusive interests, clothe it with the sanctity of a religious system, set it up for worship among men, and then proceed to ostracize a government which ventures to give a prior place to the authority of reason and the principles of justice in the shaping of measures for the well-being of the people at large. The collective holding and the nationalization of certain forms of property rest upon a moral basis quite as secure as that of private ownership of property. No man in his senses believes that it is wrong to prevent the people being injured by monopolies, or to develop public resources with public money for the public good. As a matter of fact, however the Commission does not compete with private companies in the generation of power, and, while it is true that the transmission lines of the Electrical Development Company are being duplicated between Niagara Falls and Toronto, that Company has long term contracts with the Toronto Electric Light Company and the Toronto Railway Company, its sole Toronto customers for power, and these contracts are not being disturbed in the least degree. In no other part of the Province is there any transmission line worthy of the name, owned by private enterprise, with which the Hydro-Electric Commission will compete. There has, therefore, been no interference with existing contracts. It has been said that the project violates a covenant given by a prior government. The reply is simple—it does not, for no such covenant has ever been given.

The Commission has contracted to purchase the power it requires at reasonable rates either at the generating stations or at the termini of the transmission lines of certain existing private companies, and it is thereby taking the position of a customer and supporter of such companies rather than that of a competitor and assailant.

In the third place, I would observe that the special legislation to stay certain actions which were intended to block the expressed will of the people and to validate certain contracts were, notwithstanding assertions to the contrary, normal exercises of the legislative power. If it is competent to the Provincial Legislature to prescribe the procedure by which municipal councils may ascertain

and give effect to the wishes of the people, it is equally competent to the Legislature to vary the procedure when it is being employed by unexpected methods to block the wishes of the people, and, in this case, it was done at the request of the municipalities concerned. If you will take the trouble to read the masterly report prepared by the Hon. Mr. Foy, Attorney-General of the Province, upon the actions stayed and the contracts validated, and which has recently been transmitted to the Federal Government, I think you will agree with me that this particular complaint rests upon a very insecure foundation.

I pass now to the consideration of the next ground of complaint, viz., that governments and their creature commissions are inherently incapable of efficiently conducting business undertakings, and that, in consequence thereof, the public will be penalized instead of benefited by the effect of the legislation in question. If this is the general rule of government experience, then in the province of Ontario we must have an exceptionally capable Government, because we do not admit for one moment that we have had any such experience, or that there is the slightest foundation for these charges of the prophets of evil. As a matter of fact, however, broad generalizations on questions of this sort are of no value. It is absurd to contend that effective and economic corporate action cannot be procured among men. The highest degree of administrative skill is found among corporations. Government action and Hydro-Electric Power Commission action are forms of corporate action. It has not been decreed that one form of corporate action shall exhibit all the virtues and powers and another form all the vices and imbecilities of men. The quality of corporate action depends on the character and calibre of the men and not upon the type or purpose of the corporation. History sustains the theory of effective government management quite as strongly as it sustains the theory of ineffective government management.

As a matter of fact, under our modern democratic system, which ensures the constant employment in the service of the State of a large part of the best brains of the country, it is ridiculous to assert that such brains are barred by the mere atmosphere of the service of the State from that efficiency of conduct which would characterize them in the atmosphere of private life.

In this particular project, however, it is to be noted that the enterprise is of the highest technical type, both by reason of the nature of hydraulic and electric problems and by reason of the scale upon which the Hydro-Electric Power Commission is dealing with them. The scheme of transmission is the largest in the world, and electric power will be transmitted at the highest voltage known to the art, viz., 110,000 volts. I do not think that there is any other power transmission undertaking in operation in the world to-day at 110,000 volts. It is, however, possible that by the time this project is completed, there will be one other 110,000 volt transmission plant in existence. Whether or not, however, I am strictly correct on this point, it is clear that the operation and installation of the undertaking calls for the employment of engineering talent of the highest order, and of the most highly specialized type. An executive staff of the necessary high and rare capacity may be relied upon to work on a corresponding level of efficiency, whether in the employment of the State or in the employment of the private individual.

To sum up: the objections that have been taken to the legislation in question, and which are dignified with the high sounding names of "constitutional," "moral," and "economic" objections, are all, according to my humble way of thinking, explicable on a very simple principle. It seems to be a universal characteristic of human nature that where 5% is being made, 6% should be striven for, and when 6% is earned, 7% should be aimed at, and so on in an increasing action, it is natural for those interested in any department of commercial activity to object to anything and everything that would curtail, or threaten to cur-

tail, their immediate or prospective returns, and all these high-sounding objections, or nearly all of them, could probably, if one had the time or the inclination, be traced to the motive of self-interest in the class or classes affected.

III.—The Scope, Progress and Value of the Undertaking—The field for the activities of the Commission comprises the whole of the province of Ontario. It is, however, proceeding with its enormous and responsible task in a rational way. It was the public recognition of the great needs of the manufacturing districts of western Ontario and the vast untapped reservoir of Niagara falls that led, as has already been explained, to the creation of the Commission, and it was, therefore, natural and proper that to this particular part of the field the attention of the Commission should first be directed.

Before sketching the physical project which is in process in the district named, I should, however, mention that contracts have been made for the purchase of power from existing companies at Ottawa and at Port Arthur, and for the sale thereof to the municipalities of Ottawa and of Port Arthur. These have been productive of great satisfaction in these municipalities.

In the city of Ottawa, for years prior to 1901, the following rates were charged by the Ottawa Electric Company:—

House lighting, 15 cents net, per kilowatt hour;
Street lighting, $65.00 per arc lamp per annum;
Motive power, $40.00 and upwards, per H.P. per annum.

During this time, I am informed, the Company paid no dividends. In addition to settling an acute triangular struggle within the city of Ottawa, the particulars of which it is not necessary to repeat to this audience, the Commission contracted, in July, 1907, for the purchase of power from the Ottawa and Hull Power and Manufacturing Company, whose generating works are in the province of Quebec, for a period of ten years at the price of $15.00 per H.P. per annum, and for the sale thereof, on the same terms, to the city of Ottawa.

Prior to this, the city's right to purchase current direct from a power company had been successfully assailed in the courts, and it was, therefore, left with a distributing plant on its hands but without any source of supplies. As a result of the mediation of the Commission, the city has, since 1907, been enabled to procure an abundant supply of power at a price which, in turn, has permitted the continuance of a schedule of prices as follows:—

House lighting: 7 1/5 cents net per kilowatt hour, or a reduction of 50% on the prices of 1901.

Street lighting: $45.00 per arc lamp per annum, or a reduction of 31% upon the prices of 1901.

Motive power: $25.00 per H.P., per annum, or a reduction of 37½% from the prices of 1901.

The reduction in prices has so stimulated consumption that, together with the increased demand which has accompanied the growth of the city, the business both of the city and the Ottawa Electric Company has greatly increased, the Company now paying 5% dividends on its outstanding capital stock of $1,000,000, and having, in the year ended 31st December, 1908, added an ample surplus to its reserve account. The gross revenue of the city electric plant for 1908, was over $106,000, with a net profit of over $17,000 after paying interest and making provision for an adequate sinking fund to retire the capital invested.

In the city of Port Arthur a most unsatisfactory state of affairs between the municipality and the Kaministiquia Power Company has been terminated by

similar mediation on the part of the Commission. As a result thereof the Commission has contracted to take its supply of power from the Kaministiquia Power Company and to sell the same to the city of Port Arthur on terms which are eminently satisfactory to both the vending power company and the purchasing municipality.

It may also be worth while describing a very interesting situation which developed in Hamilton, and the result thereof. The Commission did not, at the outset, expect to render much service to the people of Hamilton, by reason of the Hamilton Cataract Company's control of the De Cew Falls power, which is situated quite close to the city, and which is the cheapest development in the Province, its original source being the Welland canal. To take other power into Hamilton was like taking coals to Newcastle. It was found, however, upon investigation, that prices in Hamilton for power and lighting services were higher than in Toronto, where the power was generated from steam plants. The scale was as follows:—

SERVICE.	HAMILTON.	TORONTO.
House lighting	10 cents k.w.	8 cents k.w.
Commercial lighting.....	15 cents k.w.	12 cents k.w.
Arc lamps.....$84.00 per annum.		$69.35 per annum.

Upon the expiry of the city lighting contract, tenders were called for and submitted on the basis of $80.00 per arc light per annum, with a ten-year franchise, or $85.00 with a five-year franchise. The City Council then asked the Commission to submit prices, whereupon it estimated the cost of arc lamps as $43.00 per annum. The Company then came down to a $47.00 rate, and got the contract for five years. Subsequently the city called for prices on power for water-works and sewage disposal, and tenders were submitted by the Cataract Company at $45.00 per H.P. per annum, while the Commission estimated the service as being worth $17.50 per H.P. per annum.

The Cataract Company then offered to supply the city at rates 10% less than those charged by the Commission to any municipality. Both offers were submitted to the ratepayers, and, as a result ,a contract with the Commission was duly authorized and executed.

It is worth while noting at this juncture that the advent of the Hydro-Electric Power Commission to the electric power councils of the cities of Hamilton, Ottawa and Port Arthur has not been productive of that destruction of private interests that has been so freely and recklessly predicted. On the contrary, in these municipalities the offices of the Commission have resulted in strengthening, but on a sound and healthy basis, the position of the private power companies, while securing material benefits to the public consumers of light and power.

Coming now to the Niagara peninsula and western Ontario, I will proceed to outline, as rapidly as possible, the main features of the project. The Commission has entered into a contract with the Ontario Power Company to purchase not less than 8,000 H.P., and as much more as it requires, up to 100,000 H.P., for a term of ten years, with provision for three extensions for additional periods of ten years each, at the price of $9.40 per H.P. per annum up to 25,000 H.P., and $9.00 per H.P. per annum if the quantity taken exceeds 25,000 H.P. The power is to be delivered by the Ontario Power Company to the Commission at Niagara Falls at 12,000 volts, and the prices cover a twenty-four hour continuous service.

The physical project begins with a transformer station at Niagara Falls to take the power on delivery at 12,000 volts. Thence a 60,000 H.P. double transmission line operating at 110,000, volts conveys the current to a controlling sta-

tion at Dundas, whence the line is continued east to the city of Toronto without —in the meantime—any intermediate station. From the controlling station at Dundas a double line of the same capacity and voltage is continued *via* Woodstock and London to St. Thomas, with local transformer stations at these points. From the same central controlling station at Dundas a similar line proceeds north and west *via* Guelph, Preston, Berlin, Stratford, St. Marys and on to London, with local transformer stations at each of these points, the whole high-voltage line thus described comprising about 300 miles. At each of these local transformer stations the voltage is reduced to 13,000 for the purpose of supplying, by additional local feeder lines, the different municipalities in the vicinity thereof. The effect of this method of distribution is to make it possible from the high-voltage circuit above described, in combination with the low-voltage local distributing lines, to supply the needs of practically every municipality within the district at the four corners of which are Toronto, Niagara Falls, St. Thomas and Stratford.

The ultimate termini of the said high-voltage transmission lines as determined by economic limits, will be Windsor in the west and Kingston in the east, the additional territories to be tapped by such extensions to be fully fed in turn by a continuance, where necessary, of the local low-voltage distributing lines. This will cover the whole of the south-western portion of Ontario from Kingston to Georgian bay and south, leaving the north-eastern portion of Ontario from North Bay to the St. Lawrence river to be covered by a similar system which, in due time, will doubtless be established at the most appropriate generating points within the district.

The present arrangements of the Commission include the supplying of fifteen municipal corporations with their respective power needs up to an aggregate of approximately 27,000 H.P., over the lines described and now under construction, viz.:—Toronto, 10,000; London, 5,000; Guelph, 2,500; St. Thomas, 1,500; Woodstock, 1,200; Galt, 1,200; Hamilton, 1,000; Stratford, 1,000; Berlin, 1,000; Waterloo, 685; Preston, 600; St. Marys, 500; Ingersoll, 500; Hespeler, 400; New Hamburg, 250.

Provision has been made for the supply of larger quantities, from time to time as they are required, and also, for the extension of the service to all the municipalities within the area which it is proposed to feed from Niagara Falls.

The municipalities have agreed to pay the Commssion for the power in question on the following basis, viz.,—

(1) The contract price of the Ontario Power Company at Niagara Falls, plus

(2) 4% per annum upon that part of the construction cost which is properly applicable to each participating municipality, plus

(3) An annual amount sufficient to create a sinking fund which in thirty years, shall completely pay for that portion of the construction cost which is applicable to each municipality, plus

(4) That proportion of the line loss and the general operating and maintenance charges which is properly applicable to each municipality.

The annual inclusive rates, so computed, payable by each municipality, have been carefully estimated and reduced to the following H.P. scale, viz.,—

Toronto	$18.10	per H.P.	per annum.
London	23.50	"	"
Guelph	24.00	"	"
St. Thomas	26.50	"	"
Woodstock	23.00	"	"

Galt	22.00	per H.P.	per annum.
Stratford	24.50	"	"
Berlin	24.00	"	"
Hamilton	17.50	"	"
Waterloo	24.50	"	"
Preston	23.50	"	"
St. Mary's	29.50	"	"
Hespeler	26.00	"	"
New Hamburg	29.50	"	"

Theise rates are for power delivered at the municipal sub-stations at 13,000 volts. Each municipality assumes the responsibility for acquiring or providing the necessary local distributing system, and the maximum cost to the consumer on the above consumption will be the above prices, plus the respective local distributing costs.

While the intricacies that enter into any comparison between the costs of hydro-electric and steam power of the varied character and on the scale dealt with herein, are such as to make those most familiar with the question particularly chary about instituting them, it would be a pity to leave this branch of my subject without endeavouring to state, in at least roughly approximate figures, the monetary value to the community of the savings effected thereby, as compared with a corresponding supply of electrical power derived from coal and steam plants located at the sites of the respective corresponding municipal sub-stations. While, therefore, I do not put forward the figures I am about to submit as an exact estimate of the difference, and, therefore, of the economic value of the undertaking as limited to meet *only the stated needs* of the municipalities referred to. The exact quantity of power contracted for, amounts to 27,350 H.P. which, at the various rates given, averages, as nearly as possible, $22.00 per H.P. per annum. This, you will bear in mind, is the cost of power available for continuous consumption during the whole round of 24 hours daily. Now, if coal and steam plants were erected on the proposed sites of the various municipal sub-stations for the purpose of developing the same quantities of electric power for a continuous 24 hour full load service, the average cost of such would amount to certainly not less than $60.00 per H.P. per annum. (A monopoly would fix the price of electric power at just under the coal-steam cost, or whatever the traffic would bear. The difference is $38.00 per H.P. per annum, which on a consumption of 27,350 H.P. amounts to $1,039,300, or, say, $1,000,000 per annum. As the consumption increases, the unit cost, of course, decreases with the effect of greatly swelling the unit and aggregate savings. The capitalized value at 5% of savings amounting to $1,000,000 per annum is $20,000,000. That is to say, that, if the consumers in question desired to exchange their annual savings of $1,000,000 for a present single payment in hand, they would receive from anyone wishing to make a 5% investment therein the sum of $20,000,000 for them.

The true economic value of these savings cannot however be calculated, because they will be employed from year to year in extending the trade, and in increasing the competitive efficiency of all engaged therein. The investment and reinvestment of such increasing income-bearing advantages cannot be stated in monetary terms. But it is obvious that, in these days of increasing international industrial competition, their value, when made available for the people of the whole Province, is of incalculable consequence; and the conception of which they are begotten is of corresponding dignity.

I should also note that, had this matter been left exclusively in the hands of private companies, their tendency would have been to get the easiest market for their output by inducing manufacturers to settle within easy distance of Niagara

Falls, and by selling in large blocks to large users. Under the policy of the Commission, the benefits are being distributed throughout the Province to large and small users alike, thus contributing to a well balanced and general development, rather than an abnormal expansion of one district at the expense of others.

The progress of the work to date may be rapidly described. The sub-stations are all practically completed, so far, that is, as the buildings are concerned. Of the transmission line towers, about one-half are erected, and the balance will be erected within five or six months. The electrical equipment is under construction, and should be completed and installed within six months. Power service will be furnished each municipality in order of completion, and all should be supplied within six months. By these means, it will be possible to compare accurately the relative efficiency of each municipality and develop in the fullest degree the art of competitive efficiency. All the local municipal distributing plants are likewise under construction. Mr. R. A. Ross, of Montreal, has acted throughout as the consulting engineer of the Commission, and it is only right that I should acknowledge in the most ample way the great value of his services.

Meetings of the municipal engineers concerned, have been held at frequent intervals during the past year, with the object of standardizing all possible features of the undertaking: *e.g.*, the establishment of a uniform scale of power and lighting rates, subject only to different discounts to provide for differences in general conditions, is being aimed at, together with a uniform system of accounting and the standardization of the technical equipment of the municipal distributing systems.

I should also add that the total estimated cost of the finished project was $3,500,000, and that the actual cost, as determined by the contracts let, comes well within that figure. From this, it follows that the estimated H.P. rates given the municipalities are safe and assured.

IV.—Effect Upon Vested Interests—I have already made passing reference in two or three places to the effect of the work of the Commission upon vested interests. I shall briefly summarize these and add one or two additional remarks.

At Port Arthur the Kaministiquia Power Company's interests have been distinctly steadied and improved by the mediation of the Commission between that Company and the municipality of Port Arthur. The same effect has been secured at Ottawa.

In the Niagara peninsula there are four Canadian companies, viz., Canadian Niagara Company, Ontario Power Company, Hamilton Cataract Company and the Electrical Development Company. The Canadian Niagara Company has not been affected at all by the work of the Commission. Its activities are entirely on the United States side of the river. The Ontario Power Company has been strenghtened by the acquisition of a contract to supply the Commission with from 8,000 to 100,000 H.P. Its position has been distinctly and greatly improved by this contract. The contract was made at a low and very favourable rate for the Commission, but it constituted for the Ontario Power Company purely additional business, which enabled it to improve its position even by the acceptance of a low price. The Hamilton Cataract Company is still carrying on, as heretofore, a large and successful business.

The smoke of battle has gathered mostly over the head of the Electrical Development Company. It was offered—but it declined—the privilege of supplying the Commission with a part of its requirements. It remains in full possession of its Toronto line, its Toronto customers and its Toronto contracts, and it will, doubtless, sell at profitable rates, for all time, as much power as it can produce. All the talk of the injury inflicted upon this concern may be brought to

a very simple test. Have its securities appreciated or depreciated in value? The lowest price of its bonds in 1907 was 72 and the highest, 84. In 1909 the lowest price rose to 82¼ and the highest to 90¼. If this Company had been injured in any degree by the Commission, the market prices of its bonds would have reflected the injury. On the contrary, they have steadily improved in value.

To sum up: The Commission is not engaged in the generation of power in competition with existing companies; it has violated no contract, nor has it employed coercion in its dealings with them; instead, it has strengthened several such by purchasing from them large quantities of power and establishing them on a firmer contract basis.

By the construction of its transmission lines, it proposes to distribute much of the power so purchased throughout parts of Ontario that no existing company is in a position to serve. The wreckage of vested interests with which—according to many newspapers—Ontario is covered, is not visible to any search party that I have been able to organize. As a matter of fact, while the public has already received great—and will yet receive greater—benefits from the work of the Commission, vested interests of private companies have been justly dealt with and have been greatly strengthened.

V.—The Probable Future of the Commission—If the construction project, now nearing completion, answers, as I have every confidence it will, the expectations formed of it, the future of the Commission will be devoted to the completion of the work begun. The Government is not a trustee for the interests of any particular group of municipalities or any particular part of the people to the exclusion of the rest. Its obligations are the same to all the people and to all their municipal institutions. In prosecuting this work, however, just as it will not be deterred by slander, neither will it be hurried by impatient clamour. It will proceed cautiously and prudently, step by step, testing and proving its way, that its progress may be real and enduring. An abundant supply of motive power is to the manufacturing arts what blood is to the human body. It is their very life. And upon the progress of the manufacturing arts depends the future of this country in the international markets of the world. Supremacy in these arts gives employment and prosperity to the people at home, influence and power to the country abroad, and, in combination with the unbounded granaries of the west, it assures to the Dominion a beneficent as well as an honourable place in the civilization of that, as yet unshaped, Imperial future to which we all look forward. Nor would I forget the patient toilers on the land. Back of, and sustaining, the manufacturing arts are the great agricultural classes, the keepers of the granaries of empire, the ultimate source and foundation of moral and political strength, as well as of material greatness.

To raise the standard of living, by multiplying and cheapening the comforts of life, for these great classes is one of the prime objects of the Commission. That it will ultimately be accomplished I have no doubt whatever. This is the task to which I have set my hand. This is the task to which I shall devote my public life. It is no ignoble work. I am not ashamed of it. I am well assured that the vilification of the present will give place to the vindication of the future. Its consummation will contribute to national strength and national greatess. I hope and believe that the work so initiated in my own Province will be carried forward by the National Commission in all departments of our national heritage.

Hon. Mr. Grimmer: Mr. Kelly Evans has acquired a national reputation in his line of work. In New Brunswick we have heard his oratory and enjoyed it and derived much benefit from it. I have much pleasure in introducing Mr. Kelly Evans, who, I am sure, will not fall short of the reputation he has justly acquired.

SESSIONAL PAPER No. 52

Then followed an address by Mr. Kelly Evans, Commissioner, Ontario Game and Fisheries Commission, on

FISH AND GAME IN ONTARIO.

Mr. Evans said:

As the Chairman has stated, I have been engaged, for the last four years, in endeavouring to arouse public opinion to the importance of conserving one of our great resources. But, in addressing this meeting, I feel very much as a lawyer might who had been accustomed all his life to addressing juries and who, for the first time, had an opportunity to address the Supreme Court composed of a bench of judges. I realize that you all have a great deal of information in reference to the general proposition of the conservation of our resources, and instead of preparing a paper in advance, I waited till I had an opportunity of listening to the splendid address of the Hon. Mr. Sifton in order that I might be able to draw from it certain lessons which I thought would bear upon the particular resources I have most at heart. The Chairman of the Commission mentioned that a lifetime could be spent in the study of the most minor of our great resources, and, even then, we would not know all about it. In that statement he gave me an opportunity to still further amplify that thought by making the remark that, even in the least of our resources, there may be, as it were, some small bayou which might take a lifetime to explore. Take, for instance, the matter of fish culture and fisheries. There is a professor in a great university in the United States who has been, with a corps of students, more than four years studying the one subject of the oxygenation of water and its effect upon fish life and fish culture.

I should like, with your permission, to give some slight illustration of what waste has been going on, especially in the fisheries of our inland waters in the province of Ontario. It so happens that the blue books give us the value of the Fisheries of Ontario for a considerable period of years, but, in these statistics, while great stress is laid upon the value of the fish, no stress whatever is laid upon the quantities of fish taken. Food being in question, I think it is pertinent on this occasion to draw the attention of the Commission to the diminution of the food supply of the people in connection with our fisheries. Yesterday, I had an opportunity of looking over the report of the Department of Fisheries for the year 1873, and I found that certain alien corporations, known popularly as the American Fish Trust, have been most interested in the extirpation of the fisheries of our inland waters. It is not pleasant reading for them that I should give the figures I intend giving to you because they have been endeavouring to circulate the idea among the people of this country that the value of our fisheries is not decreasing. It is true that, if any of the members of this commission examine without analysis, the blue books as they appear before you, the conclusion would be arrived at that there was no need for alarm. As a matter of fact, what is shown in the blue books would lead you to believe that, in reality, there was very little diminution in the number of fish taking place.

Just as those who first exploited the forest wealth of this country took the most valuable species of wood, the pine, so those exploiting the fisheries of Ontario took the most valuable of our fish, the whitefish. Let us consider the position with regard to this: the total catch of whitefish, in 1873, was nearly five million pounds and to-day it is less than two and a half million pounds. The decrease appears to be in round figures about 2,350,000 lbs., but remember that the engines of capture have been greatly improved since that time and many more men are engaged in the work. In valuing this food diminution at its present

price, it would show that, in the value of whitefish alone, a decrease has taken place to the extent of quite $250,000 a year which, capitalized at 5 per cent., would show that the capital value of the whitefish alone has decreased, between 1873 and 1907, by $5,000,000. There has been really no necessity for this alarming decrease having taken place. In 1892, a Government Commission, after taking testimony throughout the provinces, reported to the Dominion Government some alarming facts. Old fishermen who gave their evidence in 1882 spoke of the good old times, when they took as many as 90,000 whitefish at a haul with the net at Wellington beach, and said that, instead of endeavouring to use sewage for fertilizers as the Chairman has suggested, they acted upon the principle of using this valuable human food as manure upon the farm. The quantity of whitefish and other fish then in lake Ontario we have no record of, but that it was immense there can be no gainsaying. That gives an illustration of what might be called waste, and it also impresses upon the Commission the very point the Chairman has brought to its attention, viz.: that the Commission may be able to investigate and get information not now at hand, in reference to these natural resources.

But, while the members of this Commission all realize that the commercial fisheries are one of our great natural resources, I do not think it is quite so clear to people generally, that the game fish and the game of the country should be included as a great natural resource. My main object in addressing you to-day is to endeavour to give you certain figures and information which may induce you to believe that the game fisheries and the game should be considered, not only as one of our resources, but as one of our principal resources. Now, to get figures upon this point is rather a difficult proposition. Mr. Byron E. Walker, no doubt, could give us, even from memory, what the returns are from our cereal crops, from our mines, from our forests, and from our economic resources, but I doubt if he could give the members of this Commission the slightest idea as to what money value the game fisheries and the game, say in the province of Ontario, represent. Now, in order that I may give you something that you will readily undrestand, I wish to take as my illustration in this respect, the state of Maine, in which the conditions are long past the stage of experiment. In the year 1867, the State Government appointed a Commission to enquire into, and report upon, the condition of the game fish and the game of the State, and, when that Commission reported, it stated that the game fisheries were valueless; that there were no moose in the state at all, and that deer could be found in only one portion of the state. Following this report, stringent laws were placed on the statute books of the State, and, in an attempt to enforce them, it is regrettable to find that some of the first game wardens were murdered. But, finally, the importance and the value of fish and game protection gained ground in the State, and what do we find to-day? In 1902, the Legislature of Maine, in order to set at rest some disputes as to what the monetary value of their policy had been, caused a census to be taken of the visitors who came into the interior portions of the State during the year. That summer a census was taken carefully and, when the returns were brought down, the people were amazed to learn the immensity of the traffic; for no less a number than 133,885 persons had come into the interior portion of the State that year. Now, the Government believes that $100 per head is a very conservative estimate of the average amount of money that each man will leave in the State from the time he crosses the border line until the time he leaves. From my own knowledge and experience I may say that, in my opinion, $100 per head is a very considerable under-estimate. But, accepting these figures, you have the gigantic sum brought into the state of Maine, annually, of about $14,000,000. Later on, I took the matter up with Hon. L. T. Carleton, the Commissioner for the state of Maine, to endeavour to find if any change had taken

place since 1902. Some of you gentlemen may consider that a man like Mr. Carleton might be enthusiastic and apt to exaggerate the figures touching his own department. But, such is not the case. He wrote me that the Government had no further information to give but that he was taking up the matter with Colonel Boothby, general passenger agent of the Maine Central. My experience of railway men has been that they are hard-headed and long-headed business men as a rule, and Colonel Boothby wrote that, from the statistics in possession of his railway, and from the information he had been able to obtain from other railways, he believed that, in 1907, 250,000 people had come into the interior portion of the state of Maine, to the best of his knowledge and belief, mainly attracted by the excellent fishing and shooting furnished. If you apply the ratio of $100 per head spent by each visitor, you will find that, in that year, $25,000,000 in hard cash was brought into the State from this source, and left there. Now, the state of Maine is about one-eighth the size of the province of Ontario, and our geographical position to take advantage of that particular traffic is just as good as is that of the state of Maine, in reference to the great Mississipi valley, and more particularly in reference to New York state and the densely populated towns immediately to the south of us. At all events, the figures I have quoted will give an idea of the amount of money there is in fish and game properly protected.

It is the attraction to tourists in which the value consists, and I would point out to the members of the Commission that money attracted this way has a peculiar economic advantage to the country that gains it. Can you realize how many sticks of timber it would take to produce $25,000,000 net; how many pounds of minerals, what quantity of cereals, or how much capital? But in this case our fish and game attract the money brought in by tourists. This money is left with you, and represents a net gain, because, in return, you give for it practically nothing more than a little bit of healthy amusement. This is a view I would like you to consider seriously. I would ask you to take that view of it rather than the view which is apt to be taken by some people, that fish and game protection has no economic advantages and that it is all sentiment.

The Ontario Government placed on the statute book three years ago a non-resident angler's tax, and I flatter myself that I was partially instrumental in getting that tax imposed. It was done originally at the suggestion of the Ontario Forest, Fish and Game Protective Association. My particular object in that $2 fee, known as the non-resident angler's tax, was not the revenue derivable therefrom, although I have no doubt that the Provincial Treasurer takes considerable satisfaction in the fact that this year he has received from that source nearly $20,000; but, my principal object in advocating its imposition was that we might have some satisfactory information as to the number of sportsmen who visited us, and that we might show you, gentlemen, and such men as Mr. Byron E. Walker, that there was, beyond doubt, money in the game fish of the province of Ontario. The $20,000 received from that tax, this year, is positive proof that, at least 10,000 persons came into the Province primarily to fish, and, if you figure on an expenditure of $100 per head, as they do in the state of Maine, the Province gets from that source, at least $1,000,000. Now, that tax has only been collected for the last three years, and the machinery for the collection of it is not thoroughly perfected yet. I have other sources of information than the records, and I am quite sure that it is possible to collect at least twice that amount at present, and, if you will take my word for that, you will see that it brings the expenditure up to $2,000,000 for fishermen visiting in the province of Ontario. But it must be remembered that each person who comes in and pays that non-resident tax is not alone, and that many of them are fathers of families and bring with them some members of their family, so that there are a great many more persons actually

coming into the country than those who angle. I think I am safe in saying that there is probably brought into the province of Ontario at least $5,000,000 annually, and this would not come into the Province were it not that we have reasonably good angling.

But I wish again to rely upon that excellent address delivered by the Chairman. I noticed that, in it, he insisted upon the importance of preventing forest fires, and I know that the Hon. Mr. Cochrane takes a great interest in this particular form of protection of our natural resources. Now, it may be possible that this policy inaugurated by the Ontario Government of collecting a $2 non-resident angler's tax may be still further extended. The people have paid that tax very cheerfully, and, speaking as a private citizen, I think it is only fair that those who take advantage of our great public parks, over the management of which Hon. Mr. Cochrane presides, should pay a small registration fee, and in that I would include our own citizens. Part of this fee could go towards the revenues of the Province and towards the employment of more fire wardens. But, above all, the great advantage of such a fee would be that it would enable us to have a record of those persons who go into these regions ostensibly for the purpose of fishing and shooting, but who, often, in their negligence, are the cause of forest fires.

There is another idea which I would bring to the attention of the members of the Commission, showing the advantage of protection of our fish and game. It is this: that very often persons who are attracted to us in that way gain information in reference to the other resources of the Province and make investments here. Some years ago I heard the Hon. Mr. Carleton, of Maine, address a meeting in Boston, and he stated that he knew of two or three investments in the state of Maine which, in the aggregate, would amount to $3,000,000, and the principal directors of these companies had admitted to him that their attention was first drawn to this opportunity for investment when they came into Maine to fish. Strange to say, a year afterwards a man whom Hon. Mr. Carleton does not know at all, but whom you all know, Mr. Wallace Nesbitt, late one of the judges of the Supreme Court, made a statement before the Georgian Bay Fisheries Commission, to the effect that he knew of an investment in the province of Ontario of over $1,000,000, that had resulted entirely from the visit of certain gentlemen to the Province, who had been attracted by sport.

The Chairman of the Commission in his address also referred to the question of public health, and here is where that particular portion of his address coincides with a certain phase of the propaganda I am most interested in, viz., that fish food is a great advantage to the maintenance of public health. It so happens that the province of Ontario is far removed from the seaboard, and the price of sea fish is rather high, and it also happens that, though the machinations largely of the American Fish Trust, about 95 per cent. of the fresh-water fish catch in the province of Ontario goes to the United States. We are, therefore, face to face with a practical issue; the difficulty of obtaining fish in our Province. And, if the contention is correct that fish food is almost a necessity if the people are to be absolutely healthy, the problem is still greater. There are many ways of looking at the value of our food-fish in the province of Ontario—I am speaking now of the commercial fisheries—outside entirely of the approaching depletion of our waters. It is true that, if we sell this food supply to our neighbours to the south, we obtain a certain revenue therefrom, but I should judge that it is one of the objects of this Commission to examine, for instance, whether we are justified from the point of view of the public health in allowing the continued exportation of our fish, especially when we are face to face with the approaching absolute depletion of our supply, and when it is known that this food is going to the people of a country who, after all, are aliens to us. I think that I

see, if I am not wrong, somewhere in the distance the question looming up of the prohibition, for a term of years, of the export of all food-fish from the Province of Ontario. I think that question may come up for the serious consideration of this Commission.

In the half-hour at my disposal I have endeavoured to give you some idea of a particular branch of conservation, and, in conclusion, I will point out that the conservation of the commercial fisheries, the game, the game fisheries and the forest, are all inextricably interwoven, and that any action taken with regard to one, must necessarily be action taken with regard to the others. I trust that those who come after us will have no reason to complain that we, of the present generation, have not done our duty in preserving these great assets which Providence has given to us.

WEDNESDAY EVENING.

The Commission reassembled at 8 o'clock p.m. in the lecture hall of the Normal School. The chair was occupied by Honourable Francis L. Haszard, K.C., Charlottetown, Premier of Prince Edward Island.

Mr. Haszard: Ladies and Gentlemen,—The first paper on the programme is by Mr. F. T. Congdon, M.P., Dawson, on "Fur-bearing Animals in Canada, and How to Prevent their Extinction." The subject is one of great importance in Canada. Even in the part of the country from which I come we have a class of animals that is becoming highly important, and we hope that, in the not far distant future, it will become more important and much more numerous, as these animals have in recent years been conserved and taken care of. I refer to black foxes, which have been successfully raised in Prince Edward Island, and I have no doubt that what can be done in that Province can be done in other parts of Canada. I shall ask Mr. Congdon to address you.

FUR-BEARING ANIMALS IN CANADA, AND HOW TO PREVENT THEIR EXTINCTION.

Mr. Congdon said:

Mr. Chairman, Ladies and Gentlemen,—

I trust that no one will imagine that I am an expert on the subject of fur-bearing animals or on the fur trade, simply because I am making a few remarks this evening. I happened to mention to the Chairman of the Commission a few things that had been communicated to me by those interested in the fur trade in the Klondike, and Mr. Sifton asked me if I would not prepare a short address on this subject for the Commission. My own knowledge of fur-bearing animals is gathered very largely from books, partly from my own experience in hunting, trapping and rambling through the woods and wilds, but most of it, from conversation with hunters, trappers and fur-traders.

The industry was at one time, as you know, the all-important industry in Canada, and at that time, if one may judge from history, it was too rigidly controlled by the authorities. We appear, then, to have passed through a period—and we have scarcely emerged from it yet—in which too little attention has been paid to the fur trade by the authorities in the Dominion of Canada.

The importance of the trade will be gathered from the statistics on the subject, which afford some very peculiar figures. It will be found that our export of undressed fur skins amounted to about $2,443,000, for the year ending March 31st, 1909. Of that, about $1,200,000 worth went to Great Britain, and some-

thing over $1,000,000 worth to the United States. I do not know what opportunities the customs officials of Canada have to determine what the export trade in fur is. I know that I have frequently gone out of Canada into the United States from the Yukon territory and have taken furs along with me. Coming from the Yukon, we take the first boat that happens along, whether it goes to a Canadian port or to Seattle, and I do not think I have ever come out myself, or ever known many others to come out, without taking furs, very often, to the United States. I never thought it necessary to make any entry at the Customs. I based my judgment of the accuracy of the figures in regard to the export trade in furs on what I know personally of the trade from the Yukon territory. The Yukon is credited for the year ending March 31st, 1909, with an export of only $19,500 worth of furs. I know of one man who came out during that year with at least $25,000 worth of skins. The reason for this inaccuracy is that no one is required to make an entry in regard to furs taken out of the country. I do not know what means the Government has of determining the amount of furs taken out of this country by the Hudson's Bay Company in its vessels *via* Hudson bay to England. I do know that, both in the Hudson Bay district and in a great part of the north, those who come into the country to purchase furs bring their goods from abroad and take the produce of their exchange with the Indians and trappers out of the country, so that very little benefit, apparently, is derived in Canada from the trade.

A peculiar feature of the statistics on the fur trade is that the export trade in undressed furs from Canada is practically the same as the import in undressed furs into Canada. The export trade in undressed furs is worth $2,443,000, the product of Canada, and the imports of undressed furs are valued at $2,674,418. We import from the United States undressed furs to the value of $1,918,755. If we add together the imports and exports of furs into this country, we find that there is a trade aggregating about $5,000,000, exclusive of the trade in dressed furs. The only explanation of the equality of imports and exports that I can think of, is that we export expensive and import cheap furs.

Thus it will be seen that the fur trade is one worthy of some consideration and attention in the Dominion of Canada. I was very much surprised in reading an article on the subject to-day to find that the export fur trade of the United States is greater than it was in the old days when the buffalo and other fur-bearing animals abounded in that country. The reason is that, to-day, the export trade in skunk, muskrat and fox skins from the United States exceeds in value the export in the old days when furs were much more abundant and when one would naturally expect the trade to be of much greater importance.

I wish to speak of this subject to-night simply in the commercial sense. I do not wish to touch upon the habits of animals or anything of that kind, but merely to treat of the fur trade as a commercial asset of the country.

The most serious losses in the fur trade to-day in Canada are occasioned by three causes: the first, the use of poison; the second, the lack of restraint in trapping; and lastly, the prevalence of wolves. The fur dealers will tell you that very little poison is used, because they will not give the same price for the skins of animals killed by poison as for the skins of those killed in the ordinary way by the use of traps. But I have enquired among the trappers about the matter and they tell me that, when an animal is killed in the cold weather, in the cold northern climate, it makes practically no difference to the skin, and that it is difficult, if not impossible, to tell whether an animal has been killed by poison or by trap. I believe that some claim that the blood-vessels immediately beneath the skin show more blood when poison is used. The use of poison is far-reaching in its evil effects, because, I am informed, that one animal that is poisoned with strychnine, the poison generally employed, will carry that deadly

poison through no less than seven removes; that is to say, if an animal eat the flesh of another that has died from strychnine poisoning it will die, another eating its flesh will also die, and so on through seven removes from the first animal poisoned. Thus one may imagine the tremendous destruction caused by the use of poison.

It is difficult, in Canada, to regulate the use of poison, but it seems to me that the strongest and most severe measures should be adopted to entirely prevent its use by those engaged in the fur trade. In the Yukon, restraint on importation of poison could be made very effective. It has also been suggested that trappers should be required to register before entering on the business and also, to report exact particulars of their catches. Imperative requirement of entry of furs sought to be exported, ought to be imposed, as it should be for all exports, if for no other reason than for statistical purposes.

Another serious injury is due to the pressure of the market demand. It is a well established fact that there are cycles in fur production. What the length of the cycle is I do not know, but the occurrence is undoubted. The Hudson's Bay Company has kept records which show the occurrence of cycles during which fur production reaches a maximum, goes down to a minimum, and so on, up and down in fairly regular cycles. The improved modes of trapping now adopted by the trappers, the vast extent of territory formerly uncovered by pioneers, but which is now occupied by them, the immense improvement in traps and in all sorts of weapons create this danger: that when the production of furs is at the low point in the scale, the animals may be extinguished. When the production is at the mximum there is not, of course, the same danger. One difference between hunting by trappers and by Indians is that, while the Indian, whether through laziness or Providence—I would be inclined to attribute it to the former—always leaves a stock of all the fur-bearing animals in a district to continue the species, the white man does not. He goes into a "creek" and absolutely extinguishes all the individuals in it, and therefore makes it impossible that it should be restocked from any individuals left in the district.

Another danger is from the enormous increase in the number of wolves in many districts in Canada. I can see no other way in which that difficulty can be met than by increasing the area over which the bounty is allowed for the killing of wolves. Of course, in doing this great care must be taken to ensure that the killing is not done by poison, but by some other method that will extinguish the wolf and do no injury to other animals. It has been suggested that, if a particular wolf in each district were inoculated with some disease fatal to wolves, he might communicate it to other wolves and so extinguish them. But it is a very rash plan to adopt without further investigation to determine whether other evil effects would not ensue.

A skin that we particularly prize in the north and all over Canada is that of the marten. Other skins are fashionable and popular for a season or two, but I think its excellent quality, beautiful texture, softness of fur and uniform beauty of shading ensure that it will be a permanently valuable fur. A strange thing has occurred this winter in that a fur not highly esteemed in the past, the lynx, has suddenly become popular and valuable. Three years ago lynx could be bought for from $2.00 to $2.50 a skin. I am informed that the only reason for the enormous increase in value has been a discovery by the Germans, the adepts in dyeing, of a process of treating and dyeing that skin beautifully. Moreover, its rounded form gives an air of rotundity to tall, slight ladies that is highly desirable. I think that the popularity of this fur will not endure and that other furs will take its place. Of course, each season shows a popularity of some particular kind of fur, but marten and the richer furs will always be highly valued.

I do not know just what methods should be adopted in eastern Canada for

the preservation of game and fur-bearing animals. It seems to me that the greatest benefit to the perpetuation of species would be derived from the creation of reserves over the country. It is a harsh measure to establish a general close season over the enormous extent of land in Canada capable of sustaining fur-bearing animals. By that course you inflict a great hardship upon trappers and pioneers. A widespread measure is difficult to enforce, but it seems to me that, if there were a great number of reserves established in various parts of Canada, these reserves being not too expensive in character and not intended to be permanent reserves, except in certain cases, you might, in that way, greatly encourage the increase of fur-bearing animals.

In the Yukon there are hundreds of square miles where I do not think you could now find a single fur-bearing animal. They have been absolutely exterminated by hunting, trapping, or by the decrease of the food supply which occurred in the years 1904-5. I believe, with regard to these areas, that if small reservations were made, in each of which there was an endeavour to encourage the breeding of some particular fur-bearing animal, a vast amount could be accomplished. I think it would be better to make the reservations smaller and limit each reservation to the protection of some particular animal. For instance, one reservation might be specially designed for breeding the marten, another for breeding the fox, and so on. These reserves would furnish a stock which would supply the surrounding country. It would be desirable that these reserves should be maintained for a period and then thrown open and other reserves created elsewhere in their places.

The great cause of the falling off in the number of fur-bearing animals is undoubtedly the disappearance of the rabbit. It is well established that, in some parts of Canada, there is a decrease in the number of rabbits, and in some sections they have almost disappeared. I remember that, up to 1904, every season I came by stage from Dawson to Whitehorse, 300 odd miles, I was never out of sight of rabbits for a hundred miles. You would see them everywhere, sometimes scores at a time. In that hundred miles there must have been tens of thousands of rabbits. In 1904-5 some disease smote the rabbits and they died off by thousands. I remember one night at a road-house we saw twenty or thirty rabbits around a stack of hay. Each of us caught one, and we found that they were all on the point of dying and did die before we left. That year the rabbits so completely disappeared that, up to last winter, it was almost impossible, in the extensive regions of the Yukon, to see a single rabbit. In consequence of their disappearance, the animals which fed on them—the fox, (the wolf, which need not be counted) the marten, whose chief food, however, is mice, and other animals —died from absolutely no other cause than starvation, and it does seem to me worthy of consideration, whether, in those large regions which we have in Canada and which can be valuable for nothing except mineral production and fur-bearing animals, it is not desirable to carry on investigations to ascertain whether some means could not be provided by which, on the septennial disappearance of the rabbit, some other food should take is place. I believe the hare, for instance, might be introduced into these regions of the country, and it might so happen that the period of disappearance of the hare would not synchronize with that of the disappearance of the rabbit. Undoubtedly the hare is as suitable for northern climates as the rabbit can be.

What I particularly desired to bring out with regard to this subject was the lack of any considerable study of the subject by any authorities in the Dominion of Canada, and I wish to invite the attention of the Commission to the necessity of investigating these various matters.

I have mentioned one fur, that of the marten, because I deem it the finest of all furs. There are, in addition, the mink, the otter, the fox, the ermine and

innumerable other fur-bearing animals in Canada of great value; but I think it would be desirable, in the reservations I have spoken of, to give special attention to the better class of these fur-bearing animals and to endeavour especially to increase and multiply them and make them a source of greater revenue to the people of the Dominion of Canada. The low point of the cycle, with regard to the fur trade has been passed. In 1904-5, or, possibly, in the following year, the very lowest period occurred in the fur supply in the northern lands of Canada, and I think this is true of Canada generally. We are now on the upward turn, and it seems to me that this is the time in which an endeavour should be made to stock some of the enormous unused lands in Canada with fur which will be valuable in the future. If it served no other purpose, it would supply a means of livelihood to the Indians, to whom we owe at least something, and it would ensure a larger production of furs in Canada than we have at present.

I would invite the attention of the Commission to one other question, and that is whether Canada could not develop to a greater extent the dyeing, dressing and manufacture of furs. It seems a strange thing that we should export about $2,500,000 of undressed furs and should import undressed furs of the same value, and that we should be able to dress the furs we import and not be able to dress the furs we export. I think that steps should be taken to enquire into the causes governing that, to inquire into this whole trade and to endeavour to devise some plan which will ensure its being of greater advantage to the people of Canada. I do not know that any one can, at present, say what is most likely to develop this trade. It seems to me that the first work of the Commission in regard to many subjects that are now being broached for the first time before the Commission, must be to collect the information which will enable them later to develop and devise intelligent methods for increasing this trade.

In answer to a question respecting the quality of the mink from the Yukon Territory, Mr. Congdon said: I understand from fur dealers that the fur of the Yukon in many lines, mink included, is the very best in Canada. They say that the furs obtained in the Yukon are larger and finer in shape than the furs of any other part of Canada. That is particularly true with regard to the marten. The marten of the Yukon more nearly approaches Russian sable than anything else in the world. I think it is worthy of enquiring whether we could not import Russian sable into Canada. I do not think myself, that it is, in any respects superior to the Yukon and northern marten, but there undoubtedly is a strong prejudice in favour of the Russian sable, and the possibility of stocking parts of Canada with it is worthy of consideration. I need not mention the values of these furs. A marten skin of first class quality is worth $15. If you match it and have ten skins of the same quality well matched, they will bring $500 easily. If we can by any means increase an industry that already yields $2,500,000 annually, it is surely worth attempting.

In answer to a question whether the beaver could live in the Yukon, Mr. Congdon said: Oh yes, you find them on all the rivers. I would like to take some of you up some of those rivers, because you would find them ideal, not only for fur-bearing animals, but for human beings. You can travel for hundreds of miles on rivers equal to the Ottawa, and I cannot imagine the world affording any more wonderful field for the production of fur-bearing animals. If the Government cannot do anything else for the fur trade in the north country, they can let the land out for pelting farms, and I would be as much in favour of giving a bonus to such an industry as to any other.

THE CHAIRMAN (Hon. Mr. Haszard): The next paper on the programme is that by Dr. Peter H. Bryce, M.A., M.D., Chief Medical Officer, Department of the Interior, Ottawa, on

MEASURES FOR THE IMPROVEMENT AND MAINTENANCE OF THE PUBLIC HEALTH.

DR. BRYCE said:

To comprehend adequately the meaning of all that is implied in the term "National Health," it will be necessary to realize that, while the nation's health is primarily measured by the number of deaths in any given population, yet, from a national standpoint, it may further be understood as indicating the maintenance of the largest possible number of effective citizens, viewed from the standpoint of their economic value to the State. Thus, a nomad population in a temperate upland, living in simple fashion with its flocks and herds, may, under such conditions of life, naturally maintain a very high degree of individual health, and yet, from an economic standpoint, be but little comparable in social effectiveness with a busy industrial urban population living under sanitary conditions which have been rendered so good through present day scientific knowledge as to be compatible with the highest individual health.

It is, therefore, apparent that one must clearly distinguish, as Prof. W. Z. Ripley phrases it, "between the physical environment, which is determined independently of man's will, and that social environment which he unconsciously makes himself and which, in time, acts and reacts upon him and his successors in unexpected ways."

This is well illustrated, in his "The American Commonwealth," by the Hon. James Bryce, the British Ambassador to the United States, who says:—"The very multiplication of the means at his [man's] disposal for profiting by what nature supplies brings him into ever and more complex relations with her. The variety of her resources, differing in different regions, prescribes the kind of industry for which each spot is fitted; and the competition of nations, always growing keener, forces each to maintain itself in the struggle by using to the utmost every facility for the production or for the transportation of products."

Accepting these several dicta as expressing the generally accepted philosophic thought of to-day, we shall find that behind them lies the conception expressed by Dr. James A. Lindsey, M.A., of Belfast, in a paper on "Darwinism and Medicine": "That the organic world is the scene of an incessant struggle, of a keen, vital competition in which the fittest survive—that is, the fittest for the environment—in their capacity to obtain food, resist their enemies and propagate their kind, while the unfit perish, has been recognized as the fundamental law of life."

As Weismann says, this principle has become the basis of the science of life; it "has conquered the world and has become so inwrought in the texture of our thought that it is now practically impossible to think of any biological problem except in terms of evolution."

We can, therefore, clearly see that "The process of life is, as we begin directly to distinguish, a process of development which is, beyond all doubt, overlaid with a meaning that no school of scientific thought in the past has enunciated."*

The consideration of our subject naturally leads us to enquire what are the problems which a people have to consider as affecting their national health. Our people inhabit the northern half of a continent extending from the 42nd parallel to the pole, whose eastern rocky coasts are washed by the waters of the polar current; whose western shores are laved by the temperate waters of a warm ocean stream; whose western portion, with its warm valleys, is ribbed with mountain chains having their slopes dipping eastward to the boundless plains of

* Benjamin Kidd, "Western Civilization."

the interior, which, again, reach to the forested areas of a low-lying rocky range, extending for thousands of miles. Such areas supply every condition for the development of the great basic industries of civilization. In adapting themselves to all these varied conditions of climate and occupation, Canadians, at the same time, have to devise means of preserving their health.

I.—Value of Population as a National Asset—Not until the value of population as a national asset is fully comprehended will any people be prepared to exercise systematically, either as individuals or as a community, those precautions necessary either to maintain or to improve its health to the highest degree possible under its particular environment. To-day France is struggling with a practically stationary population, and finds it necessary to go to its Algerian provinces to recruit its army; while its ancient rival, Germany, sees her population increased from 38,000,000 in 1871, to 68,000,000 in 1908, and her industrial population from 15,000,000 to 40,000,000. In the latter country, so vital to national greatness is population deemed, that the Kaiser has agreed to educate the eighth son of every family in Germany.

To illustrate the fact by a more familiar example, Ontario, which increased its population from 450,000 in 1841, to 1,396,000 in 1861, with an increase of revenue from about $700,000 to about $3,500,000, grew but slowly from 1871 to 1900, having an increase in population of only 563,293, the total births being 1,200,000. For all Canada, the population in the several census periods was:—

1871	3,485,761
1891	4,833,239
1901	5,371,315
1906	6,320,000

The intimate relation between population and progress is seen in the trade returns:—

	EXPORTS.	IMPORTS.
1870	$ 84,214,000	$ 55,181,000
1906	283,282,000	231,483,000

It is interesting to supplement these figures by those for the same periods in the United States:—

POPULATION.	TRADE RETURNS.	
1871—38,558,371	(Imports—$	435,958,408
	(Exports—$	392,771,768
1890—62,622,250	(Imports—$	789,310,409
	(Exports—$	857,828,684
1906—84,154,009	(Imports—$1,226,562,000	
	(Exports—$1,743,864,000	

But the most remarkable illustration of the relation between national prosperity and a sturdy and industrious population is seen in that area called the twelve north-central States. The population was, in 1870, 12,981,11; in 1900, 26,333,006; while the value of farms and farm improvements increased from $3,451,000,000 in 1870, to $9,563,000,000 in 1900. The population, which was made up of 60% foreign born or the children of foreign born, produced more than 50% of the total agricultural wealth of the United States in 1900, and had

in all the twelve States a death rate lower by 3 in 1,000 than for all the United States.

While immigration is thus shown to be a most potent factor in national development, it is yet more important, as illustrated by German statistics, that the native-born population shall have a normal increase both by a high birthrate, and the preservation of the infants born. Assuming a natural annual increase of 15 per 1,000, within 15 years over one-third is added to any normal population. Further, it is apparent that, within fifteen years from birth, some 35% of such a populatiaon would move into the class of at least partial producers and, were the nation's existence at stake, into the ranks of her defenders. But, it is further apparent that the preservation of the lives of the workers in the periods beyond 15 years, and of the mothers of the nation, who go to recruit the population, is equally a part of the programme of conserving the national wealth and resources. In a word, it is apparent that we must attempt what H. C. Patten, M.A., M.H.O., Norwich, England, in a recent article has called "The State Standardization of our National Life." He says: "We say implicitly that it is to the national interest and vital to our social welfare that every child shall receive a minimum amount of education. . . In all sobriety and earnestness we must think out for ourselves and endeavour to make others realize what are the essentials of a healthy communal existence, what standards in feeding, in housing, in medical assistance, in education, in physical training, in recreation, we are prepared to advise."

II.—The Preservation of Infant Life—Dr. George Newman, Chief Medical Officer of the Board of Education, England, has said that it is "evident that the problem of disease and physical unfitness from infancy to the end of school life is, broadly speaking, one and the same; and that the conditions and circumstances, whatever they may be, which produce a high mortality rate, are also exerting an injurious influence on the childhood of the State much beyond the age of infancy."

To understand the full importance of the statement the following table is given:—

DEATHS PER 1,000 FROM ALL CAUSES.

	under 1 year.	1-5 years.	5-10 years.	10-15 years.	Total ages 1-15.
Mortality in England and Wales, 1907	117.62	17.58	3.37	1.97	15.00
Mortality in Ontario, census, 1900	132.00	14.5	3.3	2.3	16.30

The figures regarding infant mortality should be considered in conjunction with the facts that the average death rate in 1901-7 for the United Kingdom was 161 per 1,000, while that for Ontario in 1902 was 126. What Canada loses or gains may be seen in the figures for 1900. A somewhat greater death rate is seen in Germany, where, of 2,000,000 births annually, some 400,000—or 20%—die within the first year of life.

Figures comparable to the foregoing are given in the Mortality Bulletin for 1908 of the United States census. According to it, almost one-fifth of all the deaths were of infants under 1 year, and over one-quarter of the deaths were of children under 5 years, or there were (estimated) 273,000 deaths of infants under 1 year and some 400,000 under 5 years.

Regarding the death rate in England, Newman points out that 30% of the

mortality under 1 year of age occurs during the first month, and that the mortality is one-third higher in urban than in rural districts.

The Registrar General classifies the causes as (1) common infectious diseases; (2) diarrhœal diseases; (3) wasting diseases; (4) tubercular diseases; (5) other causes. It is worthy of notice that while the deaths under one year have not, in England, shown any notable decline, those between 1 and 5 years have, since 1860, shown a decline of 40 per cent., due, in large measure, to the municipal control of contagious diseases.

The meaning of these figures from the standpoint of economic loss will be understood when it is seen that, in the population of England and Wales, which is approximately 40,000,000, there are lost to the nation during the first two years of life, 150,000 children; while a very large number, although escaping death, have the seeds of disease. This may be seen in the results of the examination of school children under the new English Act requiring the medical inspection of all school children. Thus, in an examination of 459 school children in a single suburban London district, Dr. George Carpenter, of the Queen's Hospital for Children, found that of 459 presumably healthy children—249 boys and 210 girls between 3 to 7 and 10 to 15 years of age—234 had weak ankles or flat feet, 200 had rickety deformities, 367 had decayed teeth (1,514 decayed teeth in all), 119 had enlarged tonsils, 129 had adenoids, 21 were deaf from catarrh, 9 had discharging ears, 181 had deep cervical glands enlarged, 177, the submaxillary glands enlarged, 337, the superficial cervical, 252 had inguinal glands enlarged, 81 had hernia.

If it is assumed that the population of Canada, while in many respects better born, better fed and better clothed than that of England, has, owing to less generally developed and more imperfectly executed sanitary laws in a more severe climate, an equally high mortality as that of England, it is apparent that there will be an annual loss of 26,250 lives during the first two years of life. Actually, in 1901 the loss to Canada was 81,201 or, in a population of 7,000,000 would have been over 100,000. If, of the total children born in English, American or Canadian cities, some 8% die within the first month from birth, then it is apparent that there must exist conditions as regards either (a) the health of the mother or (b) the post-natal environment of the children, whether poor nursing, or lack of clothing or of fresh air, which are accountable for such a serious mortality. In England and in many European and American industrial centres, it is not an infrequent thing for the mothers of very young children to go to the factory, leaving the baby to be cared for at a crèche or nursery kept by one of their own class. As there is almost inevitably overcrowding, foul air, neglect and artificial feeding, it is not difficult to understand the cause of the high mortality. There is, as yet, but little of this practice in Canada, but, in certain large cities, the practice has begun. So common is the practice in England that systematized attempts to cope with it are being made. This is being done in the "Infant Depots" of Sheffield, which were established with the idea of actually teaching mothers the rules of good nutrition. They, thereby, tend to prevent, lessen and cure chronic gastro-intestinal disorders and so raise the general standard of the health of infants. This scheme, probably the most important of any public health measure for saving infant life, in order to be successful, demands an efficient staff of trained workers and health visitors to encourage, advise and gain the confidence of mothers by visiting their homes in a friendly manner rather than as officers of an inquisitorial or police surveillance.

The milk depot is to educate mothers how to prepare properly, infants' artificial food. Dr. A. E. Naish, M.A., Sheffield Royal Hospital, says "that apart from the direct benefits, which he shows are abundant in the gain of health and weight of children, this women's school for babies has succeeded in raising a spirit

of emulation amongst mothers which it would be hard to reach in any other way." It need hardly be pointed out that the school will extend its lessons to show the necessity of the better care which a mother should take of her own health. From the standpoint of conserving the lives of the future workers it supplies the most logical and potent agency yet developed in public health work. What it means will be understood when it is pointed out that, if 25% of the deaths of children under one year in England could be prevented, it would mean 30,000 lives saved annually and, at the same death rate, some 7,000 in Canada. The marvel is that almost nowhere has a civilized community hitherto organized in any country any official department intended systematically to save the lives of infants.

An organized, if unofficial work which is essentially preventive is that of the social workers of different hospitals, especially illustrated by that of the Massachusetts General Hospital, where there is a regular staff of eight trained social workers with a number of volunteers. It was found that the hospital and dispensary patients treated needed more than medical treatment. Many have no funds to buy even the medicine required. Hence the hospital workers come in preventive and curative.

How directly associated with this work is the municipal control of the milk supplied to children will be shown later in dealing with the question of public milk supplies. The work of the Nathan Strauss laboratories in New York city in supplying pasteurized milk at a minimum cost, especially during the summer, has been shown to have been the direct means of saving hundreds of babies. To illustrate only one point, viz., the importance of the care of the food of babies, statistics are given to show that, in some German cities (and similar conditions prevail elsewhere) the cause of deaths of children is due to diarrhœal diseases to the extent of from 36 to 54%. These are caused by milk through the bacteria of fermentation, for it has been pointed out that 51% of artificially fed infants have died, and only 8% of the breast fed; while in France, of the 20,000 infants who died, four-fifths were bottle fed. As applied to the preservation of the lives of the 175,000 children born annually in Canada, the importance of the fact will be fully appreciated, when it is further realized that at Heidelberg, in Germany, some 40% of all cows slaughtered has been found to be tuberculous. It will be understood how the inoculation with this disease, whose effects increasingly appear in later years, may be conveyed through the milk of cows. How potent a factor, even in the case of children, this becomes is seen from the fact that a statistical analysis of the deaths in a single English county (Dr. H. W. Taxford, M.O.H., Holland Parish Council) shows that 8% of the total deaths in the first four years of life were registered as due to tuberculosis, and 9% to disorders of nutrition, most of which were probably tubercular. The other infectious diseases in this county caused 14% of the total mortality and included 7% due to measles, 3% due to whooping cough, 0.9% due to scarlatina, and 5% due to diphtheria, while 1.7% were due to diseases of the respiratory system, such as bronchitis and pneumonia. In all, the deaths amounted to 7 per 1,000 of the total population.

It is of the utmost importance to realize that from 20% to 25% of the total infectious deaths from 0 to 4 years inclusive, in England and in Canada, too, are due to whooping cough and measles alone, both of which, in a special manner, give the bacillus of tuberculosis, if present, its opportunity of becoming the cause of a general infection.

As the death rates in this case were clearly comparable to those in Canada, it will be seen that the percentage of the population from 0 to 4 years is almost 25% of any total population. The reduction of the deaths even 5 per cent. in a population of 7,000,000 would, in five years, add 30,000 native born children to

the population. That such is possible may be inferred from the fact that in Ontario, from 1882 to 1902, with an increasing population, the deaths from the acute contagious diseases fell from 4,670 to 1,768.

What prevention in the case of a single disease may mean is illustrated by the decrease in deaths from diphtheria. Thus, there were 4,541 deaths in 1881 in Canada from this disease; 3,536 in 1891; 1,982 in 1901; while the population had increased some 33% in 1901 as compared with 1881.

III.—The Health of School Children—In any ordinary population about one-seventh die within the school ages of from 5 to 15 years. The notable reduction in deaths due to the contagious diseases of childhood has been already noted: and in no department has more public health progress been made, both in Europe and America, than in school sanitation. The progress of this branch has, within the past ten years, been extremely satisfactory, and has been measured by the extent to which the medical inspection of schools has been systematically adopted in our great centres of population. By the act of 1907, medical school inspection was made compulsory throughout England and Wales, while it has been operative in Boston, New York and Chicago for from 10 to 15 years.

In Canada, it is only just beginning. Its first positive benefit is illustrated in the early discovery of initial and mild cases of the acute contagious diseases. The value of the work may be judged from the fact that, under old time methods when no school inspection existed, out of 17,704 cases of scarlet fever in London, Eng.:—

5,279 cases were under 5 years;
6,729 cases, from 5 to 9 years;
3,187 cases, from 10 to 14 years;

or but 29% were under 5 years. In a similar outbreak in Toronto in 1897, 70% of the total cases were in school children, though the ratio of population for the two periods is 11 under 5 years to 6 over that age.

What prompt and effective work in dealing with outbreaks amongst children means, cannot be better illustrated than by a single instance which occurred in the city of Ottawa in 1903. For years Ottawa had an unenviable notoriety in the matter of contagious diseases. In 1902, there were, in all, 609 cases of scarlet fever and 234 of diphtheria. In February, 1903, a new well-equipped isolation hospital was opened, and after March, all cases of these diseases were sent to the hospital. During the first three months of the year, 161 cases of the two diseases occurred, and but 159 in the succeeding nine months, or, compared with nine months in 1902, there was an actual reduction of 75% in cases and a reduction in deaths of 85% in scarlatina and 54% in diphtheria.

Begun in New York in 1897, medical school inspection had been extended in 1906, to 5,007,244 examination of school children, who were inspected in 88,813 school visits by trained physicians. The work is carried on by a staff consisting of the chief medical inspector and 200 medical assistants, together with a supervising nurse and a corps of trained nurses. All cases of suspected contagious disease are at once excluded, 12,895 being excluded in 1906. Each medical inspector is assigned to a group of schools, which he visits daily by 10 o'clock and examines in a separate room (a) all children reported by teachers as appearing unwell; (b) all children who have been absent; (c) all returning after having been excluded; (d) all referred by the nurse for diagnosis. A routine physical examination is made of each child sent in, and a complete record of each is kept. The inspector gets lists of absentees, and these are visited in their homes. The nurses report each morning at each school at a specified time in order

to treat the minor contagious cases which were ordered to report to them. They make weekly visits to the schoolrooms to make a routine examination of the eyelids, hair, skin and throat of each pupil. The Department maintains a hospital and two dispensaries. The total number of complete physical examinations made in 1906 was 78,401. Of these, 37,000 suffered from diseased glands, 17,928 from defective vision, and 56,259 required treatment of some kind. It is at once apparent that it is the diseases of nutrition, especially those indicating tubercular infection of some part of the body, which form at least two-thirds of the total cases.

The work of prevention has been promoted in London, Boston, Germany and elsewhere by having delicate, crippled and mentally dull children brought together in special schools. This work of prevention, especially in England, has been extended to the feeding of school children in the poorer districts. It has, moreover, been found by medical inspectors of schools in one or two Canadian cities that, even here, in not a few cases, where fathers leave home early and mothers go out to work, the school children are often but poorly fed and nourished.

In a report by Dr. R. Crowley, school medical officer, Bradford, England, for 1908, it is pointed out that from 1,500 to 2,665 dinners were given monthly, and in the last three months of the year, from 1,500 to 1,900 breakfasts were likewise given. Schoolrooms of churches or other convenient places, sometimes the school premises, were utilized and meals given at a cost, including all administration expense, of 1.88d. per meal.

Giving the mid-day meal is of great educational value, teaching cleanliness of the hands and person generally, and demonstrating the great need of giving individual attention to poor children. When it is fully realized that the school is the first place where the State, under ordinary circumstances, comes into official contact with the individuals of a community and that, for some time, it largely undertakes the control of the life of the future worker or producer in some branch of industry, it is of the utmost importance that this control should be of the most perfect character, viewed from the physical standpoint. There is probably not more than one child in three who, in some particular, does not require education in physical culture to correct either inherited defects or those acquired in the home or school environment on account of bad lighting, foul air and bad seating. The first daily lesson in every school should be a graded one in physical culture, either as calisthenics or gymnastics. All the benefits of a trained militia can be had without more than nominal cost if we would utilize all our regular militia as drill instructors. It would be of the greatest benefit, both to the health of the pupil and to the discipline of the school. How slowly such reforms in methods have come is seen in the fact that, as long ago as 1859, Sir Edwin Chadwick, the father of State medicine in England, pointed out, before the Social Science Congress, that not only could 40 school boys be trained in physical and military drill for the same cost that it took to make one recruit into a soldier, but further, that it was a training of the physical frame at an age when it was readily influenced before the bony parts were set, and when the mind was responsible to teaching which became a permanent part of the boy's make-up.

IV.—Typhoid Fever—In north temperate climates the prevalence of this disease has long been accepted as the measure of organized municipal citizenship. A new mining camp, a fish-cannery town, or a summer resort place, has, with our *laissez faire* American methods, always been pre-supposed to run itself in a sanitary fashion, precise governmental supervision never preceding proper municipal organization. The fiction was apparently believed that all the sanitary requirements of a well organized community would spring up full armed like Athene from the brow of Jupiter. So far as I know, there never has been a new

settlement started in Canada which has not paid its penalty in lives, in suffering and in expense from an epidemic of typhoid, a disease, of all those which we know, the most directly controlled by an active town council and health board, through adopting and enforcing up-to-date methods of disposing of excreta and supplying good water. Though with but few of such new centres developing in the census year of 1900, Canada paid her debt to filth, stupidity and carelessness to the extent of 1809 deaths and some 20,000 cases of typhoid. The point will impress itself upon us when it is seen that, in 1907, the Ontario returns showed that, in the eighteen cities of 508,510 population, there were but 179 deaths from typhoid, while in a population of 102,797 in Algoma, Nipissing, Thunder Bay and Rainy River districts together, there were 121 deaths, or 1.17 per thousand, as compared with .35 per thousand, or over three times as many deaths per thousand as in districts where pure water supplies guarded against pollution, existed. That these deaths in the new territories were nearly all among the strength and vigour of our young Canadian manhood makes the economic loss and the story of our administrative indifference, neglect and ineffectiveness all the greater.

I cannot do better to illustrate the situation than by quoting the causes given in a report of the Provincial Health Officer of Ontario regarding a typhoid outbreak in Sault Ste. Marie in 1906. As given these were:—(1) The location of the intake pipe of the Steel plant water supply where it could not fail to pump up water from a polluted source; (2) The location of the city water pipe proper in the power canal, liable for all the months of navigation to pollution with sewage; (3) Many shallow polluted wells; (4) Unprotected and polluted springs and streams; (5) Cesspools and privies polluting well waters; (6) Surface ditches carrying filthy house water to the street gutter; (7) Filthy premises; (8) Flies carrying pollution from infected excreta to the food exposed in kitchens; (9) Use of polluted water by dairymen; (10) Personal carelessness and neglect to disinfect excreta and linen by those nursing the sick.

The recommendations made were simple: they simply advocated the removal of the ten insanitary conditions enumerated.

At the present moment Cobalt is pointing the moral and Montreal adorning the tale of the unerring vengeance which Nature takes upon those who violate her plainest laws regarding cleanliness in the disposal of organic wastes. This moral was well illustrated when twenty thousand men, or one-third, of Lord Roberts' army were rendered ineffective from typhoid at Bloemfontein, with a death roll of ten per cent.; while a similar toll was paid by sixty thousand volunteers camped in relays at Chickamauga during three months in 1898, where a beautiful park with its pure spring creeks was turned into a plague spot by official stupidity and lack of sanitary organization. The melancholy story of official stupidity and lack of sanitary arrangements in both these cases has been told us in official reports and needs no further reference, except to compare it with the results of the opposite condition in the case of the Japanese army in the Russo-Japanese war, and with the three years' operations on the Assuan dam, on the Nile, where fifty thousand men were engaged and practically no deaths, either from cholera or typhoid, occurred.

Apart, however, from the Ontario figures, which show typhoid to have steadily declined where 125 water supplies have been introduced during twenty-five years, the decennial decrease in deaths per thousand from this disease in England and Wales was as follows:—

PERIOD.	DEATHS PER THOUSAND.
1871 to 1881	.322
1881 to 1890	.198
1891 to 1900	.174
1901 to 1905	.110

Similarly, the German cities which, before their water supplies were filtered, showed death rates similar to those of the great American cities, have had the death rate reduced as is seen in the following table:—

CITIES.	DEATHS PER THOUSAND.
Hague	.049
Rotterdam	.052
Dresden	.069
Vienna	.070
Munich	.070
Berlin	.080

As compared with these, Cleveland in a single year, 1893, had 494 deaths, or more than the total in all Ontario in 1902, while Chicago, up to the year when the drainage canal was completed, had from five to six hundred deaths annually, which rate was reduced by the drainage scheme by more than 50 per cent. To show, however, that the death rate from typhoid is still excessive in many American cities, Pittsburgh may be given as an example, with its 500 deaths in 1904, in a population of 375,000. Dealing with larger figures, from the United States census of 1905 it is found that in a population in the registration states and cities there were the following deaths:—

Population.		Deaths from typhoid.
States	32,996,989	10,557
Cities	23,724,258	8,200

Or, in the cities during 1901-1904 there was an annual death rate of nearly 40 per thousand, as compared with 11 per thousand in England, 7 in Germany and 5 in Norway.

To show that scientific supervision, instead of municipal *laissez faire* and ineffectiveness, operates directly in saving life, the example of the European cities already quoted may be given; while the further facts of Japan with 40 million people having, in 1903, but 4,292 deaths and England with the same population but 4,000 deaths, emphasize the point still more. Remembering that typhoid is in a peculiar degree a disease of adolescence and adult life, the economic loss may be compared in American and German cities. When we realize that each life is worth at least a thousand dollars to the State, we find the loss from typhoid alone to be $10,000,000 in a year in 32,000,000 population, as compared with $4,760,000 in a German population of 68,000,000. The history of Ontario cities and towns, with 125 good public water supplies, as compared with some of these American cities, proves the enormous economic advantages of such freedom from typhoid; while the epidemics of Ottawa in 1888, of Winnipeg in 1906, and of Montreal to-day, give adequate emphasis to the scientific fact now absolutely demonstrated that, given the natural waters of Canada in their native purity, they are capable of supplying an absolutely safe public and domestic supply of potable water. On the other hand, it is equally true that, if through individual or municipal neglect they become polluted with sewage, sooner or later their degree of pollution will be measured by the typhoid death rate.

V.—Tuberculosis—We have spoken of the deaths due to infant mortality, to the often serious influences of school life upon health, and of the deaths due to typhoid fever, the influences at work in all these cases being, at least in part, such as the individual cannot control. But in tuberculosis we have a disease which in

a peculiar degree becomes the gauge of individual effectiveness, measured from the physical, ethical or economic standpoint. Indeed, it has been truly said that we have in nothing else so accurate a measure of the social and scientific plane upon which any modern community lives as that of its comparative immunity from tuberculosis. It is the disease of house life, not the disease of the pioneer shack town; it is the pest of the densely populated city, with its slums and overcrowded work rooms and factories, rather than of the farm house or rural settlement—albeit a densely populated Indian hut may exist even on the boundless prairie. It is a disease which, while often dependent for its evolution upon an attack of measles in the child or upon the exhausting effects of typhoid on the young man, tells especially the story of poverty, ignorance and dissipation, not alone in the individual himself, but in his parents.

Whether, or not, it is due to ingestion of food or to dust carrying tubercular bacilli, all recent scientific studies point to the fact that the larger amount of tuberculosis is the result of infection in infancy. Dr. R. W. Phillips, of Edinburgh, has recently stated before the British Medical Association that out of several groups of children selected at random in Edinburgh he found no fewer than 30% with undoubted traces of tuberculosis. Drs. Floyd and Bowditch, of Boston, have reported on ten thousand cases examined at the outpatient department of the Boston consumptive hospital and found that 38% showed definite pulmonary lesions and 30% more gave evidence of tuberculosis in some part of the body; while 67% were the children of tuberculized patients.

As the percentage rate of deaths from this disease, whether in Boston or in Edinburgh, is equalled, and even exceeded, in some cities of Canada, it is apparent that the causative conditions exist here much in the same degree as elsewhere. Thus the census of 1901 gives the following deaths:

Toronto	419	or 2.00	per	thousand.
London	43	" 1.19	"	"
Hamilton	97	" 1.80	"	"
Ottawa	136	" 2.30	"	"
Montreal	561	" 2.10	"	".
Quebec	172	" 2.50	"	"
Halifax	149	" 2.80	"	"
St. John	63	" 1.50	"	"
Winnipeg	69	" 1.60	"	"
Vancouver	66	" 2.40	"	"

As is well known, it is not alone that tuberculosis causes more than 10% of the deaths in most of our municipalities, that it is to be dreaded, but that the death itself is but the record of the end link in a chain of circumstances, which, beginning often with the delicate child in infancy, have linked themselves to the struggle for health during adolescence and thereafter, during the years when the individual has had to provide for himself in a losing game year by year, the ability to labour growing less and along therewith the revenues to maintain him or his family constantly decreasing. The most recent figures available for illustration, are those for Ottawa, in 1909, which show 137 deaths from tuberculosis in 83,000 population, or 1.65 per thousand, of whom all but 22 were over fifteen years and almost without exception, belonged to the wage-earning classes and lived in the smaller houses in the older wards of the city. When it is remembered that 80% of the population of any ordinary city are included under this class, the loss through the prevalence of this chronic disease or the gain from its diminution, will be realized by all.

Professor W. F. Wilcox, M.D., of Cornell University, has referred to two

modes of viewing the effects of tuberculosis economically, the first being the effect upon the average life of the individual and the other its effect upon the earning power of the community. He then adds: "A statement that the elimination of tuberculosis would increase each person's expectation of life at birth by a specified number of months seems to me a truer measure of the weight of that incubus on society than a statement that its removal would increase the earnings of the community by a specified number of dollars. We do not live in order to earn; we earn in order to live well."

Adapting the British Life table to New York, Wilcox quotes Dr. Hayward as saying before the British Congress on Tuberculosis in 1901, that "if there had been no phthisis the average length of life of each individual born would have been increased by two and a half years. With tuberculosis eliminated and all other conditions unchanged, a male child at birth would have an expectation of living 45.9 years, instead of 43.3; a female child at birth would have an expectataion of living 49.2 years, instead of 46.7. Owing to the special incidence of tuberculosis on the years of working life, this gain would benefit mainly the adult population. A youth of fifteen years would have an increase of more than three years in the total expectation of life, were tuberculosis to disappear." To give a concrete illustration, we may take the 115 deaths of persons of 15 years or over, who died in Ottawa last year, and by adding three years to the life of each we would be adding at least $350,000.00 to the wealth of the country.

We have already pointed out that in fifteen years at least one-third of the population of any country moves from the non-producing years, under fifteen, into the producing sphere. If a person dies before he becomes a producer, we say, economically, that the parents alone lose their outlay on his maintenance, since he has not yet been a producer; but if he dies after becoming a producer, it is as if he had left the country; or, if he remains at home and his care during illness costs more than he produces, then clearly he becomes an economic loss. Professor Wilcox, taking the figures for New York State, with a population of some eight millions, finds that 27% of the total population was between the productive years of 16 and 65, and that there were 605,519 male wage earners and 98,012 salaried officials, or 701,531 in all. The average annual earnings of all was $657.00 per annum per person. There was a total number of deaths from tuberculosis in this year, 1906, of 16,570, so that, applying the figures regarding the value of the earnings to the State lost in a single year from both men and women, Wilcox puts the loss at $52,233,467. As he puts their loss of service to the State and the further cost of their care and maintenance for at least nine months of sickness, at $2.50 per day, the total economic loss in a single year becomes $63,418,217.00. A similar death rate in Canada, with her estimated seven millions population, would mean some $54,000,000, or, estimating this on the actual death rate in 1901, it would mean a loss of actually $50,000,000 in 1908 to Canada, from deaths due to tuberculosis.

VI.—Deaths due to Industrial Causes—These are recognized *en gros* when one reads the number of deaths in any year through railway accidents and the number of persons injured; but seldom is the public deeply impressed, unless when an accident, such as that occurring at the Quebec bridge, carries its hundred or more workmen to a sudden death. The distribution of deaths, by occupation, is not easily obtainable, but a few particulars are available. Thus, in 1908, there were, in Canada, 436 persons killed by steam railways and 2,360 injured, and on electric railways, 67 men killed and 1883 injured. In the death returns of Ontario for 1907 the list of occupations gave 9,107 housewives, 4,214 farmers and 2,728 labourers; but in no other class were there more than half as many deaths as those given for accidents on railways. While the deaths due to railway and street car accidents are liable always to become the occasion of suits

for damages, and the companies, naturally, seek to minimize them, yet a much larger number of deaths probably result from the lack of ordinary precautions for safeguarding life in occupations of every kind, from coal mining down to departmental stores, through ignorance, indifference or the want of appreciation of the value of a human life. This is seen probably in its grossest form in the rough work incident to new mining camps and railway construction, where the immigrant, often ignorant of the work and of sanitary laws, is too often subjected to conditions or allowed to live under such surroundings as are wholly incompatible with health or life. Legal enactments intended to minimize such evils exist; but such camps illustrate the struggle where life in the rough is between man fighting for an existence and capital fighting for the maximum profits.

But ample illustrations have been given of how, at every stage in the life of the individual, from childhood to old age, as in that of the forest tree, man is beset with dangers. What these are, we know to-day in a very large degree, and in some measure we likewise understand how to avoid or combat them. But, as in the neglect of protecting the forests against parasitic diseases, insects and fire, and against cutting the tree before its prime, so it is too often not so much ignorance of methods as lack of the keen appreciation of the benefits to be derived from them, or a selfish greed for immediate gain rather than a waiting for deferred profits, which makes protective or conservation work ineffective either as regards trees or men.

VII.—Preventive Measures—It seems proper, however, that we should indicate what it is possible to do to protect human life against some of the more serious causes of death which have been indicated.

A—PROTECTION TO INFANT LIFE.

Though difficult in their application, the methods to be adopted are quite evident, namely: (1) better housing required. This increases with education in sanitation, morals and in provident living, and is essentially a matter for society, for the municipality and for the State to assist in. (2) Improvement of the food supply. This is primarily a question of a safe and abundant milk supply, and, as the figures given of the deaths of children fed on artificial food show, dominates in importance every other health question relating to children. After studying the problem for twenty-five years and observing the very inadequate results obtained up to date, where the problem is most advanced, I am convinced that not until the State regulates and establishes methods even more exact and scientific for the control of public milk supplies than are already utilized with regard to public water supplies—in other words, not until the State provides a *municipalized public milk supply*—will the children be in any adequate degree protected. When the milk trust obtains control of the food supply, as at present in New York, of about a million babies, and reduces farmers' profits to a vanishing point, it is surely time, if government stands in any way related to the good of the people, that it should undertake to deal both with the quality and the price of this one essential of infant life.

Illustrating the situation from the last annual Boston report, some 300,000 quarts of milk go daily to that city, of which 90% must reach it by rail. Through railway commissions, and under interstate commerce laws, the delivery of milk could be regulated by receiving on trains only such as has been shown to be up to a given standard. It could be kept cool during transportation, as fruit and butter for export are now kept, and it could be distributed by the municipality and paid for as water or gas is paid for. Instead of the pitiable exhibition of a filthy cart dodging from house to house on different streets in a broiling summer

day, ladling out almost certain death to little children, cool milk, not altered by the germs of fermentation, would be delivered from door to door on every street, and a charge made sufficient to cover the outlay of inspection and handling. There is no item in the life of a child which has for the State a tithe of the importance which the milk supply has, and to-day a filthy cow in a filthier stable, handled by an ignorant or indifferent labourer, is accepted almost everywhere as a thing to be tolerated even in a progressive community. During cholera outbreaks, sieges and famines, public authorities have hitherto policed the food and regulated the prices; and it seems high time, when nearly 25% of the children born die within the year of birth, that drastic regulations for the handling of milk should be put into force.

Taking up "Public Health," the monthly journal of the medical health officers of England, for January, 1910, just after writing this paragraph, I was pleased to find that New Zealand, that colony with co-operative schemes applied by government, has actually put into practice essentially what has been insisted upon in this address as necessary. In Wellington, N.Z., the city council has the following milk regulations:—(a) There shall be a municipal milk station at which all milk arriving by train shall be inspected and cooled, and only inspected milk shall be allowed to be sold as household milk. (b) All dairies and herds shall continue to be inspected by the Department of Agriculture and all cans and receptacles are to be approved. (c) Within six months all dairy herds shall have been tuberculine tested, and must thereafter be tested yearly. (d) Milk brought in by road need not go to the milk station if it be shown that it is delivered within four hours after milking, and should the vendor undertake to have his milk tested as to quality. (e) All dairies must be licensed. (f) All milk passing through the station must pay a nominal charge for inspection. (g) Milk sent into the city by rail must not be delivered at the station later than four hours after milking. (h) To ensure proper domestic treatment of milk the Town Council encourages the visiting nurse system and, to encourage proper feeding of infants, provides a certain amount of free milk to the poor as recommended by the nurses. (i) All milk shops must be licensed and milk alone sold, and it must be kept in specially ventilated and separated compartments.

B—IMPROVEMENT OF THE HEALTH OF SCHOOL CHILDREN.

The methods adopted for inspecting school children in New York and elsewhere have been set forth, and but little more need be urged than the adoption of such methods, excepting that close watch must be kept against overcrowding. Care should also be taken to ensure abundant ventilation, which, in many of our schools, is very partial, and to secure adequate lighting as well. The increase of short sight and abnormal vision has raised the serious question of how such is rendering employees in many lines of work ineffective as regards producing the best results in the industry concerned. Scientific lighting, ventilation and construction of workshops and stores is a matter which, as yet, is wholly haphazard with us, and everywhere eyes are being permanently injured by constant work in dark rooms lighted by the glare of electricity instead of sunlight. The system of school nurses following the children to their homes is in many instances the first forward step toward the sanitary reformation of whole households. Cases of acute or chronic disease are often discovered in this way, and aid is brought to them, while the school class is secured against infection.

C.—PREVENTION OF TYPHOID AND OTHER DISEASES DUE TO ORGANIC FILTH.

The methods to this end have been indicated in the preceding pages; but it is essential, in discussing such a problem having a national bearing, to point out

that, apart from provincial and interprovincial streams in Canada, there are twenty-three international rivers and streams, in addition to the Great lakes, which, in many instances, have already become polluted, and the rest are likely to follow with the rapidly increasing settlement on both sides of the border. To-day the St. Clair, the Detroit, the Niagara and the St. Lawrence are being grossly polluted, and the two great countries have, as yet, taken no steps towards dealing with the problem. The first move made in the matter was at the last session of the Senate of Canada, and it is to be hoped that the principles laid down in the evidence before the committee, which is now being published, will be followed by Federal legislative action. The progress made by European countries in the work of preventing the pollution of streams and in the purification of public water supplies has been abundantly shown in statistics already given; but in Canada, while the provinces have done much in some instances, interprovincial streams, like the Ottawa, await the conjoint action of different provinces or the assumption by the Federal authorities of jurisdiction clearly within their power. Though this is true, it must not be forgotten that the conservation of public water supplies is primarily a municipal consideration, to be supported by Rivers Conservancy Boards, appointed by the general Government to deal with the watersheds of our several streams. There would seem to be no more urgent or appropriate field of operation for the Commission of Conservation than that of undertaking at once the study in detail, from the public health standpoint, of the principal watersheds and river basins of Canada, which already have become populous, and, where the streams, which are the supplies of the people's drinking water, are already polluted and will become increasingly more so if preventive measures are not taken.

D—PREVENTION OF TUBERCULOSIS.

To attack the prevalence of this disease—due both to house density and municipal ineffectiveness—is to lay down a programme dealing with milk and meat foods, the housing problem, the school problem, the factory problem, and, indeed, with every sphere of human activity, where competition and the fierce struggle for existence go on. We have especially spoken of wholesome milk for children and good school air. But to lessen the mortality from industrial occupations we must look to Factory Acts to prevent overcrowding and bad ventilation, to the compulsory installation of safeguards to health, as in the grinding industry, where one-half of the employees die of pulmonary tuberculosis and where, as at Sheffield, in a single "gannister" coal mine 64 out of 76 deaths were due to consumption. The education of the workman must also be carefully looked after. With our enormously rapid development of mechanical and manufacturing industries of every kind in eastern Canada, it is most essential that the interests of workmen and their families be guarded against the dangers of trades such as those that have proved so fatal in older countries.

Reference has been made to the housing problem as one of the greatest steps towards the conservation of health. In the great cities of Britain and Germany the steps taken to deal with it in recent years have met with remarkable success; while the problem has forced itself, within the last ten years, upon the great cities of the United States. In New York new tenements, erected under strict building enactments, have been constructed within nine years to house a million people. To the social workers first, who have discovered and made known the conditions, and then to municipal administration giving effect to public opinion, are due some of the most notable results. Following active charity and municipal assistance, the aesthetic idea, to-day illustrated in town planning, has been

developed; while finally, the economist is realizing the full meaning of the conservation of human life as a national asset.

We, in Canada, attracted by the magnificent example of national development in the United States, where the population has increased from 53 millions in 1880 to 84 millions in 1905, may have unconsciously overlooked the meaning and value of an effective internal national growth and development. The most remarkable illustration of the discovery of the economic value of the individual citizen has been seen in the growth of Germany since the war of 1870. In the single matter of tuberculosis alone, there have been, within ten years, more than 100 people's sanatoria, with 10,000 beds, erected for the tuberculized workman, who takes advantage of his thirteen weeks' sick benefit from the compulsory insurance laws, to take the "fresh air" treatment. Provision, moreover, exists for insurance of working women by which authorities are empowered to give compensation for loss of time and cost of sickness in maternity cases.

If anyone is inclined to question the value of municipal, provincial or State interference in matters affecting the public health, it would appear that the illustrations taken from England, Germany and even the United States go abundantly to prove that *laissez faire* methods are no more logical in the face of foes active against the public health than they are when a foreign foe in arms attacks our shores. National prosperity in every field is demanding more and more the daily application of the scientific method in every field of human energy which, in a physiological sense, is capable of being weighed and measured as accurately as the number of foot-pounds of work obtainable from the consumption of a given number of pounds of coal, or as the number of kilowatts of electricity from a waterfall of a given height, depth and breadth. Public health is no longer to be classed as an *imponderable* but as a *ponderable* entity, to be dealt with along lines as exact as the building of a railway of minimum grades, or the getting of the highest mechanical efficiency out of a well-constructed steam engine.

Mr. H. T. Güssow, Dominion Botanist, Central Experimental Farm, Ottawa, was then called upon, and delivered an illustrated address on

DISEASES OF FOREST TREES

Mr. Gussow said:

Considerable attention has been paid in the past to the study of forest tree diseases, especially in countries where it was realized that closing one's eyes much longer to the existing dangers would result in serious losses to trade and commerce. This extremely useful study has revealed to a considerable degree the economic importance of the disease-causing organisms which may attack our forest resources.

Unfortunately, as yet, very little attention has been paid to this subject in Canada. Canada's supply of timber has often been said to be inexhaustible, and practically anybody provided with the necessary capital and permission could go and fell trees to his heart's content. There was no question of selecting, of careful consideration or of economy; the future would take care of itself; there was enough forest land to supply the whole world with timber! Yet what is the good of closing one's eyes to the fact that it may take a day to pull down a tree, but many years to grow one?

I forget, however, that I am addressing the members of the Commission of Conservation, all of whom are far more familiar than I, with this method of silent devastation that has been practised for some time. It is my intention to speak on diseases of forest trees, and I have selected from among a large number a few that to me appear to be of the greatest economic importance.

SESSIONAL PAPER No. 52

As far as the maladies of other plants are concerned, the public have had their eyes opened and little urging is required to get them to employ the best means for checking the growth of parasitic fungi, which affect the pocket by injuring the crops, or diminish our enjoyment by disfiguring our fields and gardens. But, with regard to forest trees, there is a regrettable indifference, just as if diseases could not possibly harm them, and yet, severe losses do result annually from such fungus epidemics, which are in no way checked in their progress.

Speaking generally, the diseases of trees may be divided into two groups: First, those caused by mechanical or physical conditions; and second, those where parasitic organisms, such as insects and fungi, are the principal agents involved. With some of the more important insects, my colleague, Dr. Hewitt, Dominion Entomologist, no doubt will deal, and hence the present remarks will be confined, for the most part, to diseases of forest trees caused by parasitic fungi.

It is a common observation that different types of soil and climate support different kinds of trees and other plants. The study of this subject has more recently engaged the attention of the Ecologist. But it is not always that we find certain trees growing in certain soils and under certain conditions, for the simple reason that man's efforts introduce trees into environments not peculiar to them. Nurseries and plantations of any kind supply excellent examples of their growing under conditions enforced upon them. Parts of our forests which have been cleared may again be desired to serve for the raising of young forest trees, and it is here where frequent failures are experienced. For we must bear in mind that the natural conditions are now totally changed: where formerly a humid atmosphere was present, we have now more air, and where natural shade prevailed, we have more light. The young plants that may be raised in such open woods are exposed to a marked degree to such physical influences, which would, under the old conditions, exert no injurious influence.

This exposure to physical conditions, however, is not the only factor which may induce disease; the trees are especially exposed to infections from other sources. There is particularly one fungus enemy of young seedling conifers which is known as the "Damping-off fungus." When the young seedlings have grown to a certain size under this new condition, it is by no means a rare occurence that they suddenly begin to die in larger or smaller patches, and, if no means are employed to check this progress of dying off, soon all the seedlings will succumb, and any that are planted thereafter will fall victims to some mysterious foe. The cause for this sudden failure is now thoroughly understood: it has been found to be due to a microscopic fungus which attacks the young plants at the base and kills them with great rapidity. This disease in young coniferous trees is very serious, and it is fortunate that means have been discovered to prevent it. For although we shall not for some generations experience any shortage of forest supplies, providing, of course, that some method is discovered for fighting that arch enemy, "Forest Fire," we must bear in mind that planting young trees is the next important problem in the conservation of our forests. In some countries the annual planting of certain areas with young forest trees is enforced by legislation, and, on the whole, the lumberman is much checked in injudiciously cutting down timber trees. The best results in preventing the damping-off of coniferous seedlings were obtained by treating the soil several days before sowing the seed, by thoroughly drenching it with a solution mixed in the proportion of one ounce of sulphuric acid to one gallon of water. This treatment was repeated about a week after the seedlings came up. Check-plots were used in these experiments which received no treatment and they had practically no seedlings left, while, in the treated plots, there was a good stand of fine healthy seedlings.

It is possibly due to the presence of this "damping off" fungus and its sev-

ere losses that, during recent years, large shipments of young forest trees have been imported into Canada from foreign countries, especially Europe. This importation is partly practised to obtain young seedlings of two or more years of age which are past the stage of infection from this fungus, and partly, because they can be obtained at such cheap rates that considerable time and money are saved. And certainly, nobody could raise any objection to these importations, although, quite recently, together with these seedlings conifers, there is reason to believe, that a very serious disease was imported which may develop into a dangerous enemy to our white pine forests. This throws a very different light on the practice of importing seedlings. Unfortunately we have enough diseases of our own and do not want the introduction of new ones, which, like the new "blister-rust" of pines, as this disease is termed, would endanger not only the health of our seedling trees, but attack our own original resources in the shape of old trees, as well.

In the spring of 1909, 200,000 white pine seedlings were imported from Europe into Canada. These seedling plants were stated to be attacked by the fungus causing white pine rust, a disease which has caused great devastation amongst pines in many European countries. Unfortunately the pine seedlings were not carefully examined when imported, and were planted out. However, they are quarantined and are now closely watched. I will show you, later, a few lantern slides, one of which illustrates this disease and gives details of the life history of this parasitic fungus. During one stage of its growth the fungus is easily observed by the presence of numerous orange red powdery cushions growing from a blister or swelling on the stem of the young pine, but which will appear also on the branches and twigs of older trees. The fungus produces a large number of spores, of an orange red colour, masses of which form the clusters already described. Spores of fungi may be compared to seeds of higher plants, because they are capable of germinating similarly to seeds and thus, of course, disseminate and spread the disease. They are very minute, so that a single spore cannot be seen unless examined with a microscope. In consequence of their minuteness the spores are borne easily by the air and on windy days may be carried miles away from the infected areas. The disease, however, perpetuates itself, not only by means of the spores, but also by the rootlike, extremely delicate, microscopic tubes which grow in the tissues of affected plants and which will produce, in the subsequent season, a new crop of spores.

There is another factor peculiar to nearly all rust fungi which increases still more the serious nature of the disease. The spores of rust fungi generally pass through another stage in their life history upon other plants. Thus the white pine rust spores, when shed, are not capable of germination on other pines directly, but they attack all kinds of cultivated and wild plants belonging to the gooseberry or currant tribe. The leaves of these plants are necessary for a further development in the life cycle of this particular fungus. My illustrations will show you the effect of the spores on leaves of currants. Here the spores rapidly germinate, causing many small reddish pustules to appear on the surface of the leaves, and in these pustules another form of spore is produced, which, in conclusion of the cycle of the fungus, is capable of germinating only on pine seedlings. This process repeats itself with every new generation of spores on the pines. Thus we have: First, spores developing on the pine, then passing through the second stage on leaves of gooseberries or currants, where they produce another crop of spores, which return to the pines in continuance of their cycle of life.

I do not intend to describe the damage due to these spores on the berry bushes, but shall just say that the damage there may also be considerable. I

have no doubt that you will agree that we have here to deal with a very serious enemy of our forest trees, and that my reference to this parasite will make forest nurserymen careful. Under no conditions should pines attacked by rust be planted, and precautions should be taken when importing young seedlings to obtain them from uninfected areas, or to have them examined on arrival in Canada by a competent botanist who is able to recognize the disease in all its symptoms. Since it is evident that pines and Ribes plants are both necessary to the development of the white pine fungus, the destruction of either kind of hosts must result in the extermination of the rust. Wherever the pines are attacked a search should be made all over the neighbourhood for Ribes and their destruction proceeded with.

A disease which seriously affects the value of timber occurs on our larches or tamaracks. I propose to give you a short account of the disease, which is known elsewhere as "larch canker." The same disease is reported to appear in the larch groves of North America and Canada, although practically no measures are employed on this side of the Atlantic to check it. The symptoms of this disease are the peculiar flattening of the trunk of larch trees, the copious outflow of resin and the more or less complicated cankerous spots on the stems or branches of trees. If these affected parts are regularly examined, there may be discovered at certain times a small whitish cup-shaped fungus, growing on the surface of the diseased bark. I shall, later on, show you a slide or two illustrating the disease and its cause. The fungus caps grow from the roots or mycelium which lives in the bark of the trees, and thus they may be produced, according to the severity of the disease, in more than one place. The small cups may often be observed on all parts of the trees, even to the smallest branches.

When larch canker is present and this fungus spore germinates on the bark, it pushes out its germinal tube into the tissues of the bark, where it rapidly branches and permeates the bark and extends into the active layer below from which the new wood and bark is formed. In consequence of this irritation the bark is killed and the functions of the active layer underneath it are arrested. The fungus grows year after year and the portion killed increases in size. The tree now makes every endeavour to heal these wounds by sending forth from the edges of the wound numerous new cells which try to cover the diseased part. Curiously, this fungus has its active and its passive states: during the latter the tree exerts its powers in producing new tissues intended to cover the wound, which new tissues are vigorously attacked by the parasite during its activity. A natural consequence is the survival of the strongest. This battle may go on for years, but in very few cases, will the tree be the victor. My slides will show you some of the complicated results after a number of years of this battle for existence. The result of such infections of a whole plantation is of serious economic importance; the timber is practically useless as such, and trees frequently break off at the infected places through the weight of snow or by the force of the wind.

To prevent these serious complications the trees should be carefully examined when young, and, when the first symptoms of the disease are observed, the best method to arrest the progress of the parasite would be to cut away with a sharp knife all diseased bark down to the healthy tissues and paint the surface immediately with a coat of white lead paint.

These few examples may suffice to illustrate the seriousness of forest tree diseases caused by microscopic fungi. I will now refer to some diseases caused by the larger fungi which live on timber trees generally. These fungi may grow entirely on living tissues or they may occur on timber after it has been cut down. In both instances their economic importance is considerable. I have brought a specimen, which shows on the stem of a white birch a specimen of the wood destroying fungi with which I intend to deal. The fruiting bodies of these fungi

are familiar sights on dead and living trees, on railway ties, on the timber in mines, in houses, etc. I am sure every one of you will recollect having seen them actually growing. In either case, whether growing on dead or living wood, we find the wood cells filled with minute, fine threads which penetrate in all directions. The mycelial threads of the fungi concerned in these attacks secrete a ferment acting upon the contents of the living cell. In a short time the death of the cell results and ultimately of the tree. The mycelium may also be present in trees that have been cut down, or in logs, boards, etc., where it will continue to grow till the wood is wholly decayed, that is, when all substances are dissolved which the fungus uses for food. The decay is very rapid in the so-called sap wood of the tree, which contains considerable quantities of starches and oils, while it makes much slower progress in the heartwood. Not until the threads of the fungus grow out from the wood into the air will it be noticed that a tree is diseased. Up to that time there is no external evidence of disease. The threads which appear outside the bark of a tree give rise, in some cases, to a mere film, such as is shown growing on this specimen, or they may form complicated structures, usually called "toadstools," or those hard, brownish knobs called bracket fungus, a specimen of which I have shown growing on the birch. For a long time these objects were regarded as growing on the rotted wood, and it was not until recent times that we learned that the decay was due to them. From these remarks, you will understand that when you observe any "bracket" or other fungus growing out of the trunk of a tree, it is really badly decayed within. The structure of these fruiting bodies is very varied: my slides will show you the most common ones and also the damage due to them.

That you may understand how the disease of timber trees is spread, I beg your attention for a few moments to review the structure of some of these disease-causing organisms. The specimen on the birch which I have passed round shows on the lower surface a large number of small oval pores. Hence the scientific name of *Polyporus* is given to this particular fungus. When a section is made through this layer of pores one can observe, by the aid of a microscope, a number of very minute oval bodies which are the spores of this fungus. When these spores are liberated they may be carried to other trees, and if they find suitable conditions for their development, they will start the decay which makes progress internally. When it is later discovered that fruiting bodies of fungi appear on the stem or trunk, it is too late to save the tree. The spores prefer for their development a wound that may be present on the bark of trees. In a forest, such wounds are very numerous; branches continually break off, woodpeckers make holes in stems in their hunt for trunk borers, boring beetles themselves puncture the bark, and there may be many other causes. Experience shows that open wounds are dangerous in plants, as they are in animals. Every surgeon recognizes the dangers attending upon wounds in animals, and, before the days of antiseptic treatment, the dangerous, and often fatal, results of operations were due, in many cases, to the infection of wounds by germs from the air. So with unattended wounds of trees. They may easily become infected with fungus spores or other disease germs, and with fatal results.

From these observations, it is evident in which direction salvation lies. And, if the Commission of Conservation would institute some method of inspection of forest reserves and plantations, it would be one of the most important steps in the direction of conservation of one of the most important natural resources of Canada.

In concluding my address I wish to make a few remarks on the relation of insects to forest tree diseases. My colleague, Dr. Hewitt, who will address you on problems of injurious insects of forest trees, will deal with them from the entomologist's point of view. I only wish to say that frequently one may ob-

serve fungi like *Polyporus volvatus* growing on branches and trunks of trees in a peculiar sort of arrangement. On careful examination, it has generally been discovered that the fruiting bodies of this fungus issue from the punctures in the bark caused by some bark or trunk-boring beetle. For this reason it is very evident that unless war is declared against the noxious insects, the plant pathologist cannot possibly suggest cure or prevention of diseases caused by fungi which gain an entrance through wounds caused by insects. I conclude my address by showing you some lantern illustrations which will bring home to you the urgent necessity of protecting our forests from the smaller and larger organisms that annually cause great losses, which, if expressed in figures, would amount to a surprisingly large sum.

After Mr. Güssow's paper, Dr. James Mills asked: Are these methods of fighting disease applicable to forests?

Mr. Güssow: Experience in other countries has taught that such is the case, but it is necessary to have a system of inspection such as they have in Germany. The forests are divided into certain districts and each district is inspected annually by officials who have their men knock off every part which is infected, cut off the infected limbs or break off the fungus tops, so as to prevent fructification and consequent infection of the neighbouring trees.

Dr. Mills: Does it occur on the younger growth only?

Mr. Güssow: No, it occurs on all trees, young and old. It is not always the case that these fungi will appear on the branches high up. They are found from five to ten feet from the ground and are broken off with long poles to which weights are attached.

Dr. Mills: You think, then, it is possible to apply these methods to forests?

Mr. Güssow: Yes, but it would be necessary to have some method of forest inspection.

Dr. Mills: Would the breaking off of the fungi destroy them?

Mr. Güssow: No, you must destroy them by fire.

Dr. Mills: Should not a tree so infected be marked?

Mr. Güssow: Yes, that is understood. They should be cut down as soon as possible, otherwise new fungus bodies will be produced.

The Chairman called upon C. Gordon Hewitt, D. Sc., Dominion Entomologist, Central Experimental Farm, Ottawa, who gave an illustrated address on

INSECTS DESTRUCTIVE TO CANADIAN FORESTS

Dr. Hewitt said:

One of this country's most valuable resources is the forests, which not only cover so large an area of the land, but, in many cases, are the only forms of vegetation possible in extensive areas which cannot be otherwise utilized. Nature has bestowed this source of wealth and of welfare on the nation with a lavish hand, and with an ever-increasing arm have these opportunities for material prosperity been embraced; but this cannot go on for ever. The virgin forest land is not inexhaustible, and, as the supply of such timber as Canada produces, affects indirectly interests so widely separated as mining and printing, and directly affects our material prosperity, it is not only necessary for us to study

carefully how we may best conserve this supply, but also, how, by a careful system of afforestation, deforested areas can be reafforested and how conditions in treeless areas can be improved by suitable afforestation.

My present object, however, is not to indicate the importance of forest conservation and afforestation, of which others far more competent than I have spoken, but to consider a very important factor which seriously affects these questions, more seriously than is at first sight apparent. This factor is the injury caused by insects to forest trees. Three factors are chiefly responsible for the destruction of our forests, namely, fires, plant diseases and insects, and these three factors are often closely associated. Fire may precede and make easy the path of total destruction by insects, or the reverse may occur; or, on the other hand, fungi may gain entrance to trees as the result of insect attack. Unfortunately, the extent of insect injury becomes apparent to most people only when the ravages attain some magnitude, the earlier phases of the outbreak having been passed over unnoticed. The result of this is that we frequently have a destructive species of insect firmly establishing itself unobserved by the forester or others in charge, and, instead of being able to take such remedial measures as might be possible in the early stages of the attack, we are confronted with an outbreak of so great a magnitude as to render such measures impracticable and impossible. I shall give you instances of such occurrences. Our great difficulty lies in the fact that these outbreaks occur on a large scale in wild virgin forests, in dealing with which we are almost impotent. If, however, the attack is recognized in its earlier stages, by judicious treatment of the trees in the way of felling at the proper time and other careful forestry measures, it is possible to prevent, in many cases, the destructive species of insect assuming large proportions and the outbreak, a serious character. In dealing with these forest insects it is essential that the attack shall be recognized in the earliest stage possible. If this is done, the species of insect responsible for the injuries can be determined, and, if necessary, studied, and we may be able to suggest from the results obtained by such a study the remedial and preventive measures necessary. Those measures depend upon the life-histories and habits of the insect concerned, and it is impossible, in the absence of such knowledge, to adopt the best means of controlling or preventing the further spread of the insect. It is apparent, therefore, that the conservation of our forests is greatly dependent upon entomological knowledge, and this dependence will increase with the growth of the national importance of our forests.

The combating of destructive insects is as important as the prevention of forest fires, since the ultimate results of the two are similar, namely, the destruction of large areas of forest. In fact, so similar are the results that the destruction of forest areas which has been due to outbreaks and the spread of serious insect pests, is not infrequently attributed entirely to fire. Where careful inquiry has been made into the question, it has often been found that the destruction of the timber by such insects as bark-boring beetles, preceded the fire, and again, that these and other timber-destroying beetles sometimes attack areas of timber over which fire has passed and which might, under normal conditions, have recuperated, but the beetles, taking advantage of the weakened vitality of the trees, completed the destruction. The question of insect attack is, in this way, closely, connected with that of fires.

A study of European forestry literature and the excellent writings of Hopkins on American forestry give an idea of the enormous losses which a single insect is able to cause. In the latter part of the 18th century the attacks of the bark-boring pine beetle, *Tomicus typographus L.*, resulted in the cutting down of over two and a half million trees and, in France, this insect, together with another species, brought about the loss of nearly two hundred thousand trees

before it was controlled in 1872. In the United States, Hopkins estimates that the annual loss, direct and indirect, caused by insects to forest and forest products is about a hundred million dollars. The outbreak of the bark-boring beetle, *Dendroctonus frontalis* Zimm, in the western states in 1891-92 was estimated by Hopkins, who studied the insect, to cover an area of over 50,000 square miles. Although these figures are and can be estimates only, they serve to indicate in a graphic manner the enormous losses caused, and wide areas covered, by forest insects alone.

On account of the geographical position of Canada, our forests are composed chiefly of coniferous trees, and, in describing the most prevalent and injurious forest insects, only those attacking conifers will, with one exception, be considered. We are periodically troubled by a number of seriously injurious insects attacking ornamental and shade trees, such as, for example, the White-marked Tussock Moth (*Hemerocampa leucostigma* S. & A.), which is responsible for no little damage to shade trees in some of our cities. The Fall Webworm (*Hyphantria textor* Harr), and Tent caterpillars (several species of *Malacosoma*) appear from time to time in considerable numbers and defoliate forest and other trees, but the results of their attacks are not so serious as those of certain of the forest insects attacking conifers.

The insects destructive to forests may be grouped into three main classes. First, those insects which defoliate the trees and by their continued prevalence from year to year cause the death of the trees. Included in this class we have, in Canada, such insects as the Larch Sawfly, the Spruce Bud-worm, the Brown-tail Moth, and the Pine Butterfly. In the second class are included the bark beetles and the borers. The former class of beetles are the cause of the greatest loss to coniferous trees by their attacks on the growing timber; many of them attack the healthy trees, others more weakly trees, and certain species cause the destruction of both classes. Thirdly, there are a large number of insects which affect the continued growth of the trees as a species by their attacks on the seeds, the seedlings and the young trees, but with this miscellaneous group of insects it is not proposed to deal, and the first and second groups alone will be considered.

At the present time the most widely spread forest insect in Canada is the Larch Sawfly or Larch Worm, *Nematus erichsonii*, whose injuries to the native larch or tamarack have proved very serious in the past and are to-day of great magnitude. In 1881-1886, this insect spread over the whole of eastern Canada, and, during that period, on account of repeated defoliation, practically all the mature larches over the whole of that area were destroyed. It again appeared in the east in the years 1894-8, but, in 1903, another large outbreak began, which has now assumed enormous dimensions and has spread over the whole of eastern Canada. In a recent tour out to the West, I found it on all the larches as far west as Winnipeg, and it appears as if the results would be as serious as those of the 1884-8 outbreak. Most of the larches which have grown up since that time and those which have recovered are being killed by frequent defoliation, which such a tree as the larch or tamarack is unable to stand. The seriousness of the result of this outbreak is increased by the fact that the larch grows especially in swampy and muskeg regions, where many other trees are unable to grow. In such an extensive outbreak in virgin forest, it is impossible to take any remedial measures against the insect and we are compelled to await its disappearance brought about by such factors as the destruction of its food supply and the increase of its parasites. I have not found this species attacking other conifers, even though these latter were growing among the larch, nor have I noted the sudden increase of its parasitic or other enemies.

The life history and habits of this insect have been studied in the United

States, and more recently I was able to make a study of the species in England, where a serious outbreak has occurred during the past few years. The female sawflies lay their eggs in slits which they make by means of their saw-like egg-laying organs on the stems of the young terminal shoots of the larch, and as a result of this, these shoots subsequently die. The young green larvæ hatch out and begin to feed on the fresh green leaves, and, as they grow older, they feed in clusters, gradually stripping the whole tree of its foliage. By this repeated defoliation by the larvæ and the killing of the growing shoots by the female sawflies, the larches are killed. The larvæe are full-grown in a few weeks, being then of a greyish-green or bluish-green color. When full-grown they descend the trunks of the trees and spin a brown cocoon in the loose turf and dead leaves at the base of the tree, and the sawflies emerge from the cocoons in the following June. A number of parasites have been found, insect parasites which attack the larvæ when they are on the trees, and a fungal parasite which destroys the larvæ when it is in the cocoon. I also found that a large percentage of the larvæ were extracted from the cocoons and eaten by a species of field mouse or vole (*Microtus agrestis*). Most valuable assistance was rendered in England by several species of birds, and accordingly a system of bird protection and encouragement was instituted. As there were few insect-eating birds in the district where the outbreak occurred, nest boxes were distributed, and the first year's trial was so encouraging that additional nest boxes are being distributed each year. Too much stress cannot be laid on the importance of encouraging this important means of insect control. Bird encouragement and protection form an important part of many of the forestry systems in Europe, where it is the result of both State and private enterprise and where afforestation and forestry methods are carried on in a more scientific manner than in any other part of the world. Although Canada's forests are comparatively enormous, we must, in instituting conservancy methods, in adopting schemes of afforestation and, above all, in preserving the forests in our national parks, give careful attention to this important aspect of forest preservation. We are only at the beginning of these things and have every opportunity of adopting all those useful measures of forest protection which other and older countries have discovered by experience. It is our duty to undertake every measure possible to secure the ends that this Commission, as I understand its purposes, has in view.

Considerable damage has been inflicted on the balsam and spruce, especially in the eastern regions of Canada, and also on the Douglas fir in the West, by a small moth whose larvæ is known as the Spruce Bud-worm (*Tortrix fumiferana*, Clem.). During the summer of 1909, a serious outbreak of this insect in the upper Gatineau country was investigated by Mr. Arthur Gibson, of the Division of Entomology, to which a number of reports of the abundance of this insect had been sent, and it was found that the insect was spread over a very large area. I learnt, when visiting Vancouver in October, that it had been increasing in numbers on Vancouver Island, where it was attacking chiefly the Douglas fir. In some ornamental grounds on that island I found, by the presence of the empty pupal cases, that it was also able to feed upon the larch, silver fir, Norway spruce, deodar and African cedar.

The name of this insect is derived from the fact that the larvæ feed on the leaves of the young green shoots, which are consequently destroyed, and as the spruce is a slowly growing tree this results in serious injury to the tree. In fact, it has been described as one of the most destructive insects attacking the spruce. I believe, however, that, in its work of destruction, it is not infrequently assisted to no small extent by the bark-boring beetles. It bites off the leaves or needles and constructs for itself a shelter by binding them loosely together. The eggs are laid on the leaves and the young larvæ are pale green. The winter is passed

in the larval stage, and, in the following year, they continue to feed and become mature about the end of June, when they are of a reddish brown colour. They change into pupæ in their loosely made shelters, and the small brown moth, on emerging from the pupa or chrysalis, drags the latter partly out of the larval shelter, in which position the empty case remains suspended. These empty chrysalids were found in very large numbers. I was also informed, when in Victoria, B C., that moths were carried by the wind into the city in enormous swarms, and this wind carriage contributes considerably to the spread of this insect and also, of the larch sawfly, as in the outbreaks of these insects that I have studied it was almost always found that the spread has been in the direction of the prevailing winds. The destruction of the foliage and the presence of the insect causes the trees attacked to have a reddish brown appearance, and, from a distance, they appear to have been swept by fire.

In Canada, we are, at present, threatened by a most serious defoliating insect. The Brown-tail (*Euproctis chrysorrhoea* L.), which has, since its introduction into Massachusetts about 1890, spread far more rapidly in the eastern states than the Gypsy Moth, has established itself in Nova Scotia and New Brunswick. The first specimens of these introduced moths were discovered in New Brunswick in 1902, and in Nova Scotia in 1905, and the first winter nest was found in the latter Province and sent to my predecessor, the late Dr. James Fletcher, in February, 1907. Although a most vigorous campaign has been carried on, it appears now as if the insect had firmly established itself in the forest districts, though, as yet, the numbers are not large. In the eastern states hundreds of thousands of dollars have been spent in attempting to control these insects, which were allowed to become firmly established before any steps for eradication were taken. Such an experience has taught us the serious results which would follow the spread of the Brown-tail Moth in the provinces of Canada, and, in consequence, we shall take all measures possible to prevent its spread in the provinces where it now exists and its introduction into other parts of Canada. The first specimens were probably introduced into Massachusetts on imported nursery stock from Europe, where it is kept in control by such natural agencies as insect parasites. It is found that imported nursery stock is liable to be infested with the winter nests of the insect, in which stage it is admirably adapted for dissemination, as the insect is very common in many of the localities where this nursery stock is grown. To prevent its introduction, and as nests had been found on stock shipped into Ontario, the Division of Entomology carried on, with the co-operation of the provincial authorities, nurserymen and others, a careful inspection of imported nursery stock, and nearly two hundred nests were discovered and destroyed. As each of these winter nests may contain several hundred young larvæ, the value of this work is apparent. This inspection is being repeated this year, and I hope next year we shall have legislation which will render the shipment of nursery stock and other vegetation into this country without inspection for these serious pests, impossible.

This insect is especially adapted for wide and rapid dissemination, as the snow-white moths are able to fly well and the larvæ are liable to be carried in the winter nests. The eggs are laid in batches of about 200 to 300 arranged in a brown mass formed by the brown hairs from the end of the female's body. It is from this circumstance that it derives its name. They are usually deposited in July on the under-sides of the leaves, and, in August, the larvæ hatch out. At the end of the season, they are about a quarter grown, and, by drawing the leaves at the end of a branch together and binding them with silk, they make for themselves a nest or web in which they pass the winter, coming out in the spring to feed on the newly opened foliage. In this season they become full-grown and cause the greatest destruction. The larvæ are reddish brown and furry in ap-

pearance; the hairs with which they are covered, are minutely barbed and produce a most painful and, in some cases, serious rash when they come in contact with the skin. The larvæ feed on the foliage of most of the fruit trees, such as the pear, apple, plum, cherry, and, in addition, they attack such forest trees as the oak, elm and maple, which may be entirely stripped of their leaves. The surest remedial measure is the destruction, during the winter and early spring, of the winter nests containing the hibernating larvæ. This procedure is being adopted in Nova Scotia, and several thousands of nests have been destroyed annually since active measures were instituted in 1907. It is a serious matter to control an insect such as this after it has established itself in the forests. In the eastern States it spreads so rapidly as to get beyond the ordinary methods of control, and now one of the most important experiments ever carried on in destructive insect control is being made under the direction of Dr. L. O. Howard, Entomologist to the United States Department of Agriculture. Collections of specimens are being regularly sent from different localities in Europe where the insect is native and where it is kept in check by certain species of parasitic insects and other insect enemies such as predaceous beetles. But these species are not present on this continent. The collections of the European Brown-tail caterpillars are parasitized; the parasites are carefully reared in large numbers and distributed at certain points in Massachusetts, where the infestation of the Brown-tail Moth is very serious. Several of the species of parasites appear to have established themselves already, as the species have been recaptured, and although it is naturally a matter of time, it is hoped that ultimately, by the introduction of the controlling parasitic insects, the Brown-tail Moth and also the Gypsy Moth will be controlled. If so, this will then be added to the already increasing list of instances where a thorough knowledge of an entomological problem has led to the control of a seriously injurious insect. The Division of Entomology is giving its most serious attention to this problem, and I hope that, with the co-operation of the provincial departments, we shall not experience the disastrous results which have followed its establishment in the New England states.

There are a number of other defoliating insects, such as the pine and spruce sawflies and the pine butterfly, (*Ncophasia menapia*, Felder,) which occasionally defoliate considerable tracts, but I will now turn to what are perhaps the most serious of conifer-destroying insects, the Bark Beetles, belonging to the group *Scolytidae*. The majority of them belong to the genus *Dendroctonus*, which means a "killer of trees," and Hopkins, the authority on these insects, states that, if the trees of the United States killed by these insects during the past 50 years were still living, the stumpage value of the timber would exceed $1,000,000,000. The insects of this group are destructive by their boring through the bark, under which they excavate galleries in which their eggs are laid. There the small white larvæ or grubs continue the tunnelling. In this manner, not only is the vitality of the tree impaired, but the layer of growth tissue is very often destroyed by the ramifying borings of the larvæ, and the tree dies in consequence. Certain of these bark beetles attack the strong and vigorous trees and cause the death of the same. Others attack more weakly trees, sometimes previously weakened by a forest fire, and complete the destruction. Healthy trees, attacked by the first class, on becoming weakened, may be attacked by those beetles normally preferring unhealthy trees, and thus the result of their work is intensified in character.

The occurrence and distribution of these beetles have not yet been studied to any great extent in Canada, and, as I have reason to believe that they are much more prevalent than is generally considered, and as such information and also a knowledge of their life histories and habits under the prevailing condi-

tions is very essential, I am hoping that it will be possible for the Division of Entomology to undertake a careful study of these insects. The practical importance of a more complete knowledge of these serious forest insects of Canada cannot be over-estimated.

In New Brunswick and other parts of the eastern region of Canada, great destruction has been caused to the red and white spruce and also the black spruce by the Eastern Spruce Beetle. (*Dendroctonus piceaperda* Hopk). It attacks the healthy mature trees and also those which have been weakened in any way. The evidence of its attack is the reddish dust on the bark of the trees caused by the larval borings, and also the reddish and dying appearance of the tops of the trees, which, I am afraid, has not infrequently been attributed to the attacks of the Spruce Bud-worm, whose attack is not so serious. The small reddish brown or black beetles, measuring one-fifth to one-quarter of an inch long, bore holes through the bark, thus forming a wound, and underneath this bark they excavate long galleries. Hopkins, who has studied the life history of this and many other species, finds that this takes place in the eastern States in June and July. The eggs are laid on the sides of these galleries and the larvæ on hatching begin to feed on the soft lower layer which, when the larvæ occur in numbers, causes the tree to begin to die. If the eggs are laid early in the season, most of the larvæ are full grown about August and are then transformed into pupæ and adult beetles. These beetles hibernate in the burrows underneath the bark and emerge from the trees about June, whilst those specimens which hibernate as larvæ, emerge later in the season.

The methods of control which a study of the life history of this insect suggests, are the barking of infested trees during the months in which the beetles hibernate, or the felling of as many of the badly infested trees as is possible during the same period. The barking and destruction of the bark, however, is preferable, as trees thus treated will remain sound for some time and may be felled later.

A number of species of this destructive group of bark beetles belonging to the genus *Dendroctonus* have been found in Canada in the coniferous regions of the Maritime Provinces, Quebec, Ontario and British Columbia, and a study of the seasonal histories of the different species which are dependent upon such factors as latitude, is urgently required. In addition to these bark-boring beetles, there are a large number of boring beetles whose larvæ penetrate deeper into the timber, both of living trees and of felled timber, and these are responsible for the destruction of a large amount of timber.

Not only are these timber-destroying beetles directly responsible for the destruction of trees and timber, but, by their borings, they provide means of ingress for timber-destroying fungi, which, in many cases, complete the destruction begun by the beetles. The two factors of forest destruction, therefore, are closely related in this respect. Not only do these boring beetles make way for subsequent fungal disease, but it is extremely probable that certain of the plant lice or aphides, such as the gall louse which infests the spruce and larch, by the punctures they make in the bark of healthy trees, provide entrance for the spores of such destructive fungi as the larch canker and others.

These examples of the workings of a few of the destructive forest insects which I have chosen, will serve to show you the importance of entomological enquiry in relation to the conservation of the forests and the maintenance of systems of afforestation in Canada. I trust that I have shown how exact entomological knowledge, such as can be gained only in the field and in the laboratory, must necessarily form the basis of all measures of insect control. A little knowledge is often a greater evil than ignorance, and nowhere is it so detrimental as in science and in the application of scientific knowledge. The Commission may

be assured that the Division of Entomology will, to the best of its power, furnish, by the study of these insects, such information as will be of use in checking the inroads of such insects as are destructive to Canadian forests.

The meeting then adjourned.

THURSDAY MORNING.

The Commission of Conservation met at the Carnegie Library on the morning of Thursday, January 20th, at 10 o'clock. The Chairman called upon Mr. Charles R. Coutlee, C.E., Engineer-in-charge of the Ottawa Storage Survey, to give an address on

THE WATER WEALTH OF CANADA: WITH SPECIAL REFERENCE TO THE OTTAWA RIVER BASIN.

Mr. Coutlee said:

The only source of water, no matter where we find it, whether coursing down in rivers or rising from the soil in springs, is the rainfall. This rain, flowing in rivulets on the surface or seeping through the ground, eventually reaches a creek, a swamp, or a lake, thus collecting to form a flowing river.

There are four uses of water to mankind. First and foremost, drinking water is an absolute essential to life, and this constitutes a first call upon all our sources of supply. Secondly, if the rainfall is not sufficient, plant life is possible only by means of irrigation. Irrigation, however, not only furnishes moisture, but the water conducted to the soil contains silt and mineral salts which renew the land. This is well shown in the Nile valley, where the overflow, covering the ground with silt and mineral salts, has made it possible to raise unrotated crops for thousands of years. This phase of irrigation is often forgotten, but, when more intensive methods of cultivation are adopted, many streams in the well-watered provinces of the east may yet be turned on to the land for the sole purpose of fertilizing it. In the third place, transportation necessitates an assured depth of water in our streams, and, to this end, it is necessary to conserve the rainfall in swamps, lakes or artificial reservoirs, so that low water in the autumn will not prevent a continuous service. The use of water for power purposes is the last charge upon the supply. It is a remunerative business, and so the production of energy adjacent to centres of population has been seized upon by capital which, if not controlled, would demand the whole flow for this purpose alone.

Under these four heads of usefulness each of the five river basins of Canada will be discussed, that is, under a geographical arrangement, we will consider the principal rivers in their relationship to the population. This practically means the relationship of water to each city in a particular district.

Pacific Coast—Beginning on the Pacific, the rugged coast-strip which extends 50 to 100 miles inland from the ocean and rises in that short distance to a general elevation of 8,000 feet, serves to condense the moisture-laden wind of the Pacific, the result being that the rainfall attains the extraordinary amount of 100 to 150 inches per year. The high peaks condense the moisture directly into snow, which, constantly gathering, creates a pressure sufficient in the presence of a very moist atmosphere to harden into ice which gradually moves down the mountain valleys as glaciers. These glaciers as they reach lower elevations melt into water, so that the frozen masses represent reservoirs from which the streams are fed until late in the autumn. Although the lake-basins, or natural

reservoirs, are small, still these glaciers and the heavy rainfall give a fairly constant supply for domestic and other purposes.

DOMESTIC SUPPLY OF VANCOUVER—The site of the present city was a forest in 1885. Since it was surrounded by salt water, a source of supply was selected on Capilano creek, where a pond was created by a wooden dam. The water is led down through steel pipes and carried by a submerged conduit beneath the inlet and into the Stanley Park reservoir, from which it is distributed by gravity.

DOMESTIC SUPPLY OF NEW WESTMINSTER—This city is situated on the lower reaches of the Fraser river. As the tide extends up this river, the water is brackish and unfit for domestic use. It was therefore necessary to obtain a supply inland, and a gravity system was installed.

This indicates that, even in the newer districts, the large Canadian centres of population are well supplied with water for drinking and for fire protection. The increasing and, in many cases, unrestrained contamination of streams under the conditions of rapid growth in our population indicates a necessity for central supervision of at least those rivers whose waters wash alternately the shores of different provinces. By authoritative investigation of matters relating to river pollution, the public will be led to understand that our magnificent Canadian streams should not be polluted by allowing sewage or factory wastes to enter without adequate purification.

The relation between pure and ample water supply at all seasons, and the public health, is a question of paramount importance. The ignorance of the public regarding sanitary matters and the laws governing the right to consume water from lakes, streams or springs, and the right to dispose of drainage into the same, prevents effective protest against pollution. Central control founded on technical examination, instead of adjustment through the courts, will give assurance to municipalities as to the future conditions of our streams, and, even with growth of population, the dangers will diminish rather than increase. Life will be protected, litigation will be avoided, and the municipalities will stand on firm ground respecting their rights with regard to water supplies and drainage.

Under central auspices, extended inquiry and experiment into problems of water supply, sewage and sewage disposal, would secure a fund of valuable data from which local authorities would derive benefit, and the public would understand and demand the blessings of modern sanitary research. A correct moulding of the popular mind, founded on a study of local conditions, is much to be preferred to the intermittent and unintelligent enforcement of general legislation. Annual reports, or, preferably, occasional bulletins describing the conditions of water supplies, sewers and disposal systems and projects would build up a sentiment to have and to hold our heritage of water, pure.

The studies required would be systematic examinations of the drainage areas of our principal rivers as to existing or probable pollution from towns, summer residences or manufactories. Physical, chemical and biological tests at regular intervals would determine the relative purity at different points. The determination of discharge quantities for various river basins would be of service in studying the economic possibilities of streams for future power development. It would also serve to prevent the encroachments of private dams, bridge piers, etc., upon the natural flow area—a fruitful cause of floods.

The disposal of sewage and trade wastes is now demanding a great deal of attention from scientists. The capability of a river to purify itself and the necessity of demanding a more or less perfect degree of purity in drainage entering the streams, are subjects that will engage the best scientific thought of the immediate future.

IRRIGATION—Although the rainfall is very plentiful on Vancouver Island, yet there are portions of the island which require irrigation because the moisture-laden clouds drift over to condense against the Coast range. The irrigation systems, however, are small and generally consist of creeks led on to individual ranches.

Along the coast of the mainland very little irrigation is practised, although the months of July and August are sometimes very dry, and the gravelly soil does not retain the moisture of the wet months. The islands in the Fraser delta and lower Fraser are protected from the sea by dikes. When the dikes are over-topped by the high water, the result, of course, is a refertilization which is a most important feature of all irrigation.

INLAND NAVIGATION—The rivers fall down steep mountain slopes and are generally too rapid for any kind of navigation, but the deep inlets along the coast afford access by boat to many points quite inland. It is possible to navigate the Fraser up to New Westminster with sea-going vessels, and above that there are a few stern-wheel steamboats. The Skeena is a large river with many rapids, but has been navigated for 150 miles to Hazelton.

POWER—There is plenty of coal on Vancouver island and on the mainland also, but, owing to the high price of this fuel, water-power was early sought after. About 1903, the Vancouver Power Company developed a site on the shore of Burrard inlet, 18 miles north of Vancouver. Coquitlam lake is joined by a two-and-a-half-mile tunnel to Buntzen lake, thence through wood-stave pipe, to the plant, 400 feet below. Although the drainage area is only about 200 square miles, yet the excessive rainfall is sufficient to maintain 22,000 H.P. This is transmitted to Vancouver, New Westminster and the Delta, supplying over 100,000 people with light, operating electric roads, etc. The transmission line across Burrard inlet by a single span over half a mile in length.

Another station will soon be completed at Stave lake, 35 miles from Vancouver. The drainage area is only 360 square miles, but the rainfall of over 100 inches per year ensures 25,000 H.P., the head being 90 feet. The great rainfall and high heads are, of course, most remarkable conditions.

Central British Columbia—In this area the mountains are separated by four parallel north-and-south valleys, viz., the Fraser, 400 miles long, fairly straight and almost north and south; the Okanagan valley, with Okanagan lake nearly 80 miles long; Columbia river and its lake-expansions, the Arrow lakes, extending 200 miles north and south; and the Kootenay valley parallel to, and a few miles west of, the Rockies.

The Coast range intercepts a large part of the moisture from the Pacific, so that the Fraser and Okanagan valleys are semi-arid, but the Columbia and Kootenay valleys have an ample rainfall and snowfall.

Applying our division of uses to the Fraser river, we find that it furnishes, so far, no domestic water supply. The banks are usually steep and rocky, or else high gravel slopes, which are without arable areas or towns of importance. Owing to the salmon pack, it is a question if the river can ever furnish potable water. The fluctuation of the surface is 50 feet, and the great floods carry quantities of silt which also militates against its use for household purposes. The lower reach of the Fraser, however, from Yale to the coast, is alluvial, but is exposed to extensive floods. Irrigation is practised only at a few points, so far.

POWER—There are great falls along the Fraser, with rocky canon sides, where power might be developed by the use of rock-fill dams if the river could

ever be regulated to obviate the extreme conditions of high and low water. The Thompson river, however, which enters the Fraser at Lytton, furnishes a domestic supply for the town of Kamloops, which is pumped by a vertical engine set over a well. Its tributary, the Bonaparte river, supplies irrigation systems near Ashcroft. Two large reservoirs, Adams and Shuswap lakes, modify the flow of the Thompson somewhat and offer sites for power development.

OKANAGAN VALLEY—Irrigation is practised throughout the valley, where fruits of all kinds have been cultivated with great success. Navigation by stern-wheel steamboat is, so far, the means of communication in the valley, which is reached by railway only at its north end. Power has not been developed to any great extent and no large developments are to be expected, but the fertility of the valley and its fine climate will attract a class of people who will become great users of power.

COLUMBIA AND KOOTENAY VALLEYS—There are four towns in this basin. Revelstoke, on the Columbia, obtains a water supply, not from the river itself, but from the Illecillewaet, which joins the main river at that point. Irrigation is not practised in the Columbia valley to any great extent.

Navigation on the Columbia is, so far as Canada is concerned, confined to the stern-wheel steamers on the Arrow lakes and on the river above Golden. Navigation on the Kootenay river is broken between Nelson and its confluence with the Columbia at West Robson, but is resumed between Nelson and Kootenay Landing.

On the Kootenay river, power has been developed by a very modern plant at Bonnington Falls near Nelson. The head varies from 55 to 65 feet, for, during high water, the flow becomes obstructed by the narrows below the falls. The flow is 6,000 c.fs. from a drainage area of 10,000 square miles that possesses several glaciers. Eventually 25,000 H.P. will be developed, but only one half is being developed and sold, at present, to Phœnix, Grand Forks, Greenwood, Rossland and Trail, for mine haulage and hoisting, pumping, air compression, and for lighting and municipal purposes. The city of Nelson operates a municipal plant on the opposite side of the river.

Mackenzie Basin—The drainage area of this basin is nearly 700,000 square miles. The Athabaska and Peace rivers unite to form the great Mackenzie, which presents a few power possibilities, although it flows to the Arctic in an almost even grade. They, however, admit of navigation, with interruptions at Grand rapids and at Fort Smith rapids, from Athabaska Landing to the Arctic, a distance equivalent to that from Winnipeg to Halifax. An idea of the coming development of this great basin may be had from the fact that a flour mill has, for years, been operated on the Peace.

The prairie rivers of Manitoba, Saskatchewan and Alberta drain nearly a million miles of territory—that is, twice the drainage area of the St. Lawrence—through two outlets, the Nelson and the Mackenzie rivers. It is rather a fortunate circumstance that the precipitation is not as great as that in the east, and that the area is not covered with a dense timber, because it would prevent a gradual melting of the snow by the sun during March and early April, and would cause the whole flood of melted snow and spring rains to pour down together during the latter days of April.

Lake Winnipeg Basin—It is not generally appreciated that Lake Winnipeg is the size of lake Erie, that is, nearly 10,000 square miles in area. The basin that drains into this lake is 350,000 square miles in extent, or nearly the

size of France and Spain, which two countries support a population of 58,000,000. The Saskatchewan river, which drains 158,800 square miles of this area, extends west to the mountains and from Edmonton to the 49th parallel. The mountain streams constituting the sources of this great river are very numerous. Many of them are fed by glaciers and offer a continuity of flow that promises well for water-power when an increasing population provides the demand.

The next great tributary of lake Winnipeg is the Red river, rising in Minnesota and flowing north to Winnipeg, where it is joined by the Assiniboine. From there it continues through the St. Andrews rapid to the lake. Both the Red and the Assiniboine, like the Saskatchewan, are alluvial rivers worn deep down in the prairie soil to an almost even grade, and are, in general, without the valuable falls over rocky ledges that so easily lend themselves to power development. Their swift running floods and ever changing shoals are a great detriment to navigation, especially on up-stream trips. As there are no lakes along these rivers, the spring thaws and early rains sweep down unrestrained by swamps and ungathered by reservoirs, so that their beneficial uses are largely lost to the communities along the river banks.

The prairie river generally occupies the bottom of a great depression a mile or more in width, with steep sides 100 to 200 feet in height, which are deeply furrowed by gulches of accessory streams, creeks and rivulets that are generally dry in summer. The main stream meanders through the bottom land, and during great floods, the minor banks are overtopped and the bottom of the valley flooded.

The prairie lakes are often of considerable area, 40 square miles or more, but are generally shallow. The sloughs are filled with a fair depth of water during wet years. They have no outlet streams, but in mid-summer they shrink to insignificant ponds. This decrease in volume renders them very alkaline. These peculiar conditions of the prairie water supply can be understood by giving examples of the methods employed or projected to make the most of them.

DOMESTIC USE.—Edmonton, the capital of Alberta, derives a water supply from the Saskatchewan. Calgary has a water supply owned by a private company and drawn from the Bow river. A pile dam has been made across the entire river, and a wooden flume along one shore leads the water about half a mile to the wheels. The population is now over 20,000, principally located upon a flat about forty feet above the river. Residences are now being built upon the surrounding plateau, 200 feet higher, so power for pumping must soon be increased. The coal mines at Canmore and Banff are only 80 miles distant by rail. Medicine Hat pumps its supply from the South Saskatchewan. The power used is natural gas, of which the locality has a plentiful supply. Increase of population at Calgary, Macleod and Lethbridge will bring up the question of sewage contamination at Medicine Hat, which is down stream from all these places. The same difficulty, too, will arise, later at Saskatoon and Prince Albert. Regina is at present supplied from Wascana creek. Later, it may be necessary to utilize Last Mountain lake. Brandon takes its supply from the Assiniboine, which also furnishes the power for pumping. Winnipeg, the third largest city in Canada, obtains water from a system of artesian wells. The pumping was formerly done by steam, but the high price of coal has led to the adoption of electric power generated on the Winnipeg river.

IRRIGATION.—Two exclusive irrigation schemes are now in operation. One near Lethbridge, takes water from the St. Mary river, the main canal being led along side hills and into sloughs which act as reservoirs. The system was begun in 1897, and very good results have been obtained from land that, without water,

would have yielded very uncertain crops, although, during wet years, there is sufficient rainfall for general farming. Calgary has become the centre of a large system built and operated by the Canadian Pacific railway. This Company received the final allotment of its land grant in one block near Calgary. In 1903, a main canal 100 feet wide, was begun, and now carries water from the Bow river by branch ditches, to serve 1,000,0000 acres. Further extensions are proposed for the near future.

Because the prairie rivers have cut so deeply into the soil, they do not lend themselves easily to the irrigation of the general prairie level. Their swift current, however, points to a method of pumping up the water, and as the amount required is very moderate, only 1 c.f.s. being necessary for 100 acres of land, the systems of pumping need not be elaborate. In Washington state, the current of Snake river is utilized in the following manner. A long, narrow raft is anchored in the stream: each end is furnished with rollers and an endless belt with wooden vanes or paddles is revolved over these rollers by the current into which the paddles dip on the under side of the raft, the upper paddles returning in air. The power thus generated runs a Jacobs-ladder pump that lifts the water up to a trough, through which it is led to the land. Another method of obtaining power from a river current is by a series of screw propeller wheels mounted on a shaft which is held beneath a float in the diection of the current. Windmills are also frequently used, and the winds are generally fairly constant over the area in question.

NAVIGATION—A boat, launched in the Red river, sailed down to lake Winnipeg and through it to the mouth of the Saskatchewan, thence it was hauled and poled up the Grand rapids to Cedar lake, whence it proceeded to Edmonton. This boat was used during the rebellion of '85, and finally went to pieces against the piers of the Edmonton bridge. This gives some idea of the immense stretch of navigable waters through our prairies, but, owing to the swift current, the economy of such transportation is not quite assured. If a large quantity of heavy raw material like coal or iron ore were offered for through transportation, then a system of cheap barges pushed in front of a stern-wheel steamer might be used. Such barge rafts carry coal down the Ohio and Mississippi to New Orleans, where the barges are broken up and sold as lumber.

On lake Winnipeg there is considerable navigation, largely connected with the fish industries. The new lock at St. Andrews rapid, when completed, will extend navigation to Winnipeg and above.

Although the Saskatchewan is subject to extreme freshets, yet piers for bridges have been built in the river at many places and have withstood for years the force of its floods. It is, therefore, reasonable to expect that a dam consisting of high piers upon a heavy floor of concrete extending across the bottom of the river, could be economically built. Between these piers, steel curtains, forming the actual dam, could be raised vertically during freshets, permitting the flood water to pass unimpeded. As the flood decreases the curtain would be gradually lowered into the water so as to keep the upper level at a fixed height, while the natural flow of the river passed between the lower edge of the curtains and the concrete floor. Such constructions would regulate the river into convenient steps, or reaches, each of which would form a conservation reservoir that would save for summer use the valuable water supply of the prairies that is now dissipated in spring floods. Water held at a high and constant level is always a most valuable asset to any community.

POWER—At present the prairie rivers furnish very little power, although their tributaries in the mountains are already being exploited for use at Calgary

and other points. Coal is cheap and abundant in the western section, but further east, with increasing population, cheap power will be in demand, and the moveable dams above described may yet be tried. Lake Winnipeg is an enormous reservoir 700 feet above Hudson bay. It flows out through the Nelson river, which tumbles over many rocky ridges, giving exceptional opportunities for water-power.

A great rock outcrop along the west side of lake Winnipeg separates it from lake Winnipegosis and Dauphin lake, which are 100 feet higher. This outcrop also crosses the mouth of the Saskatchewan, creating the Grand rapids, with a fall of 71 feet, 250 miles north of Winnipeg.

There is, however, a third great tributary of lake Winnipeg, the Winnipeg river, which has a drainage area the same size as the Ottawa, 55,000 square miles, or the size of England and Wales. It also runs through a similar gneissic rock territory. Its upward extension is Rainy river, forming the boundary between Canada and the United States, and emptying into the lake of the Woods. The Winnipeg river flows out of this lake over two falls, giving exceptional opportunities for power. Near Kenora 5,000 H.P. is generated and used for flour milling and for municipal purposes. The head is 18 feet, and a remarkable dam of loose rock thrown into the bed of the river maintains the elevation of the lake; the river flow, 15,000 c.f.s., is passed through stop-log sluices. Farther down the river, and 75 miles from Winnipeg, is Pointe des Bois, where the city of Winnipeg is building a municipal power station with 46 ft. head. Here, another rock-fill dam has been built.

Farther down, the river branches into two channels, and upon the Pinawa channel a power with 35 to 40 feet head is operated by the Winnipeg Street Railway Company for street railway and other purposes.

St. Lawrence Basin—The watershed area is 550,000 miles, one-sixth of which is the water system of the Great lakes, which constitutes the most remarkable reservoir system in the world. The north coast of lake Superior is rocky and sparsely peopled; consequently, apart from the demands made upon it by Fort William, Port Arthur, and Sault Ste. Marie, lake Superior is but little drawn upon for domestic supplies. The drainage of Fort William and Port Arthur discharges into the lake.

The western portion of Ontario contains numerous flourishing towns. The two chief rivers are: the Thames, flowing through London and Chatham, the latter of which derives its supply from its waters, and the Grand, which furnishes the supply for Brantford. Toronto pumps its supply from lake Ontario, the water being carried beneath the harbour through a tunnel. The drainage has been deposited without treatment in the lake, but plans are now under way to instal a large filtration plant. This cannot be too highly praised, for, although lake Ontario is too large, and the flow is too great, to admit of gross contamination, still wind storms constantly tend to drive pollution ashore, whence it is liable to be carried by flies and other agencies to the inhabitants of the city, or, what is the same thing, to the farms whence their milk supply is derived. Port Hope, Cobourg, and Kingston derive domestic supplies from the lake also, and, unfortunately, drain into it.

Montreal has, for 50 years, obtained water from above the Lachine rapids. It was conducted through an open canal to the pumping station, whence it was raised to the reservoirs upon the mountain. Lately, however, closed concrete conduits have taken the place of the open canal. Much has been said regarding the use of this raw water, and there are chances of dangerous pollution from a dense population, but, a much more pressing question is whether this great city should be allowed to pour its drainage into the river. We are inclined to expend

enormous sums to get good water, but it is far more important to be certain that this water supply is returned to the river in an unpoisoned condition. People have been accustomed to make money by supplying water; therefore, they seem to see no gain in proper drainage, simply because it gives no direct money returns.

The great tributary of the St. Lawrence, the Ottawa river, furnishes domestic supplies to various towns from New Liskeard to Montreal, a distance of 400 miles. Haileybury and New Liskeard pump by steam from lake Timiskaming; Pembroke pumps by steam from Allumette lake; Ottawa has its supply led through two miles of steel pipes laid in the bottom of the river and pumped direct throughout the city by water-power.

IRRIGATION—Notwithstanding the fact that the farm districts of Ontario and Quebec suffer annually, from drought during the summer, yet no attempt is made to irrigate, although many suitable creeks are to be found. This is remarkable because the whole population is accustomed to building small dams for lumbering and milling purposes and also to digging ditches for drainage purposes. It is a natural step to conduct water in ditches from a dam above, for use as a fertilizer, as well as for a source of moisture.

DRAINAGE—If the people of central Canada do not resort to irrigation, they undertake extensive drainage schemes. Kent and Essex counties in Ontario are remarkable in this regard, and other districts are constantly extending the area of tillable land. This is beginning to have an effect upon the rivers. Swamps are reservoirs, just as lakes are reservoirs, in which the upland drainage is collected to seep slowly through the muck and earth toward streams and rivers. When the dainage is led past these valuable reservoirs by free flow in ditches, it sweeps forward without restraint, and the rivers receive a great bulk of water in a short time, causing the annual floods that scourge many districts. Again, of the water that falls from the clouds, 50% is "fly-off," or evaporation, 33% is "run-off," or stream flow, and the remainder, 17%, is "cut-off," or stored in the ground. This ground storage serves to keep the land moist and also to maintain the stream flow during the late summer until the autumn rains restore the supply. It will be seen, therefore, what an important part the swamps play in the regulation of our streams, and I submit that they should be jealously guarded as reservoirs and as forest reserves throughout the whole Dominion.

NAVIGATION—The Great lakes and the St. Lawrence afford the greatest inland navigation route in the world. Jacques Cartier and Champlain could reach Montreal only in row boats, but, since 1850, an immense amount of dredging has been done in the St. Lawrence, so that, to-day, ocean liners of 30 feet draft freely ascend to Montreal. West of Montreal, a great system of canals has been constructed at a cost of $80,000,000, so that a 2,200 ton boat can sail from the Atlantic 2,200 miles into the heart of our Continent. This great enlargement of the actual river has, of course, improved the freedom of its flow and therefore tends to somewhat lower the general water surface from Superior to Quebec. With the increasing size and draught of boats upon the Great lakes, this lowering of the surface is making itself felt, especially in lake Erie. To maintain a navigable depth it is proposed to build a dam across the Niagara river above the Black Rock bridge. The proposition is fraught with difficulties. Storms from the south-west "pile" the water of lake Erie toward the Niagara outlet, and this "pile" upon the already raised surface will flood valuable property. Again, as part of the natural flow is arrested and held upon lake Erie, lake Ontario does not receive as great a supply, and its surface would tend to

fall, unless, in turn, its outlet were also dammed; and so on down the river through lake St. Francis to the head of Montreal harbour, where the loss of every inch in height necessitates expensive dredging to ensure, in the autumn, sufficient depth for ocean-going vessels. It is hoped, however, that a general system of raised levels throughout the St. Lawrence will yet be secured.

POWER—The St. Lawrence system, having the most densely settled communities along its banks, has been called upon to furnish power for manufacturing and municipal needs. Fort William and Port Arthur on lake Superior derive power from the Kaministikwia river at the Kakabeka falls, 19 miles distant, where a head of 175 feet generates 7,000 H.P. Sault Ste. Marie depends upon water-power for its existence. The head is only 18 feet, but the discharge is 60,000 c.f.s. and very constant. Pulp mills, a steel plant and municipal utilities are the chief users of the power. Nipigon river just below Fort William, offers great power, which will be developed when a market presents itself. Sudbury is the centre of a mining district which has received power from the Spanish river at Turbine since 1904. The head is 85 feet. Vermilion river is now furnishing power to other mines in this district. The French river has not been developed, but, as the western link of the Ottawa navigation, it may yet furnish considerable power at the proposed dam sites.

The Severn and other rivers in western Ontario have small local powers, but the great Niagara developments completely overshadow anything else in the district. Unfortunately, only half the descent between lakes Erie and Ontario has, so far, been utilized, except in the case of the Cataract Power Company, where the head is 270 feet. The Trent river, flowing diagonally through Ontario to the bay of Quinte, has several powers developed, and the dressing up of the river for navigation purposes may lead to further installations. Below Prescott, the St. Lawrence river plunges through a series of rapids, falling 100 feet in 30 miles. The sloping surface does not lend itself as readily to power purposes as an abrupt fall; and the rapid water creates ice difficulties. Consequently, nothing has been done so far, but a company is now seeking permission to build a dam and power house in the vicinity of Cornwall.

From Coteau, at the foot of lake St. Francis, to the head of lake St. Louis, 20 miles above Montreal, the St. Lawrence falls over 80 feet in 15 miles, but the same difficulties present themselves as at Cornwall. Lately, however, a power has been obtained from the Soulanges canal, and another development is proposed at Cedars; while the old Beauharnois canal has been transferred to a company that is constructing a power at St. Timothée. No attempt, however, is being made to completely dam the river, although the numerous islands indicate this to be possible, and a river arranged in successive steps is a most valuable power stream.

Montreal has had a hydraulic pumping system since 1854, but not until 1897 was an attempt made to procure power from the great Lachine rapids. Only 14 feet head was secured, and great trouble was experienced from ice. It is an example of the waste incurred by partial development. The rapid water above Montreal prohibits surface ice from Dorval down to Lachine, and large quantities of anchor ice form in this open stretch. This drifts down through the rapids and blocks the whole river in the vicinity of Montreal, so that the water rises and floods the wharves and shores in its endeavour to pass through its ice-gorged channel. If a large rock-fill dam, similar to those used on the Winnipeg river, were constructed across the Lachine rapids, then the surface of lake St. Francis would be produced to Heron island, where sluices and a power house could be constructed, making the whole flow available through a fall of 25 feet. Another dam at St. Helen island would pen up the Laprairie basin 25 feet higher than

the harbour, creating another great water-power. As the surface of these ponds would be level and quiet, they would freeze over early in the season, thus preventing the formation of the ice that now causes such havoc in the port of Montreal, and boats would pass up from the harbour through only two locks with great basins between them, instead of through the many locks and narrow channel of the Lachine canal.

Montreal also obtains power from the Shawinigan falls, on the St. Maurice, 85 miles distant, and from the Chambly plant on the Richelieu river, 20 miles distant.

Quebec has three power stations, one each on the Jacques Cartier, the Montmorency and the Chaudière. The tributaries of the St. Lawrence below Quebec present remarkable power possibilities, as they flow in rock basins with many abrupt falls.

New Brunswick—An abundant rainfall, and a snowfall which does not melt until April, fills the lakes and swamps with a store of water that keeps the rivers replenished until the autumn, when the rains augment the flow to some extent and maintain it beneath the snow. The spring melting furnishes a great body of water, most of which, unfortunately, runs away. There are several rivers with exceptional power possibilities, but, so far, only the St. John river has been exploited. The Grand Falls Power Company is building a plant at that place to develop 80,000 H.P. eventually, under a head of 130 feet. This will be used for the manufacture of pulp and for the municipal supplies of Woodstock, Fredericton and St. John, the latter 165 miles distant.

Nova Scotia—The province is 300 miles long, but only 75 miles wide. It is not to be expected, therefore, that large rivers offering great power would exist. Numerous power plants are furnishing light, but steam plants will probably form the chief source of power in a province whose coal supply is so great and so well distributed.

Domestic Supplies—These are generally taken from the local streams, which are small, but which are maintained in many places by large swamps or mosses. Pumping is generally done by steam power.

Irrigation and Navigation—No irrigation is practised.

Although the coast is navigated from end to end, and many of the rivers' mouths are entered by large tramp steamers, yet the upper reaches are too shallow or too rapid for the use of steamboats.

Power—There are several small power plants for pulp grinding, etc., but electric energy will likely be developed through steam, there being such a plentiful supply of coal.

Ottawa Basin—It has previously been mentioned that the Ottawa river would be treated last. This was because an investigation of its watershed has been made in connection with the navigation scheme, and the knowledge gained has resulted in storage works being commenced. The Ottawa watershed is very similar to those of the north slope of the St. Lawrence basin, and a detailed description is of interest because the Ottawa is typical of this class of river.

The Ottawa basin is 56,000 square miles in area. Ten thousand of this lies south of the river, and is drained by the Petawawa, Bonnechere, Madawaska, Mississippi, Rideau and South Nation rivers. Five thousand square miles drain into the main stream through insignificant tributaries. Forty thousand square miles lie north of the river. The Dumoine, Black, Coulonge, Gatineau, Lievre and Rouge rivers drain 20,000 square miles of this, and the other 20,000 square

miles, which includes the drainage area above Mattawa, forms the upper basin.

This upper Ottawa basin contains Grand lake Victoria, with an area of 40 square miles, and Quinze-Expanse, having an area of 100 square miles. The area draining into Grand lake Victoria, 4,500 square miles, contains twenty lakes aggregating 300 square miles of surface and several large rivers, the Kamshigama, Kapitachuan and Shoshokwan. At the outlet of Quinze-Expanse lake the watershed area has increased to 10,000 square miles, and the Kinojevis and Opasatika systems of lakes and rivers have increased the high-water flow from 25,000 c.f.s. to 80,000 c.f.s.

This stream now enters the north end of lake Timiskaming, having, in the intervening stretch of 15 miles, descended 300 feet over rocky barriers that present wonderful visions of water-power. All this power has, virtually, been disposed of by lease, for the remainder of this century. Lake Timiskaming extends 60 miles south from New Liskeard to Timiskaming wharf. Between Timiskaming wharf and Mattawa the river is broken by the Long Sault and Mattawa rapids with a fall of 40 feet each. To the west of lake Timiskaming is lake Timagami, part of which flows in *via* the Montreal river, and to the east of Timiskaming is lake Kipawa, draining a territory of 2,300 square miles. The latter has a surface of 100 square miles and is nearly 300 feet higher than Timiskaming. The whole basin is 20,000 sq. miles in area, and the run-off at Mattawa is 110,000 c.f.s. during floods, but dwindles down, to about 10,000 c.f.s. or less during the low-water period.

The regimen of a river, that is, the discharge at high water, at low water, and at intermediate stages, is studied by keeping a daily record of its surface at several points—lake expansions if possible—and then metering the flow at high water, medium water and low water. As the lake rises, the discharge increases in a regular ratio, and, as it falls, the discharge diminishes at a similar rate.

The lockmasters on the Canadian canal systems measure the depth of water on the lock-sills every day in the year. This has been done at Ottawa since 1844, and, owing to this most fortunate circumstance, we can deduce the discharge on each day of the twenty odd thousand days since. I cannot too strongly urge upon all who desire to conserve our water supplies this simple matter of keeping daily gauge readings, winter and summer, for, whenever information is required to develop water-power, to build locks, or to construct reservoir dams, this record is a fundamental requirement.

The record of the Ottawa river has been charted, and, from it, the following general facts have been obtained. The average flow during sixty years has been 55,000 c.f.s., or about 1 c.f.s. for each square mile of watershed. That is, if the main river and all its tributaries had the spring flood conserved in reservoirs, the flow at Besserer Grove would then average 55,000 c.f.s., instead of rising to 250,000 c.f.s. in May, 1876, and shrinking to 10,000 during the winter months of other years.

Diagrams made by the Georgian Bay Canal Survey branch of the Public Works Department show how the flow accumulates *en route* from Mattawa to Montreal during some typical years in the history of the river. The peak of the flood is always reached during the month of May, generally between the 10th and 30th. The flow begins to increase about the 1st of April and falls to normal during July, whence it falls steadily till the succeeding month of April, except for the rise due to the autumn rains during October and November. September shows the lowest water, and January, February and March are always near the danger point for power developments, thus immensely diminishing the value of the river. In fact, during the winter of 1908, it was difficult to get from this great river power enough to carry on the public utilities at Ottawa. This brought affairs to a crisis, and the local power holders came to an agreement to

construct a series of stop-log sluices across the Chaudière falls, thereby saving the water that formerly ran to waste, and also creating a head-basin to lessen the ice difficulties. The basin formed, however, is only three square miles in extent, and a draught of 10,000 c.f.s. would lower its surface 10 feet in a day. It was therefore necessary to examine the lake reservoirs along the route with a view to storage. Above Ottawa in Deschenes lake, 45 square miles in area, lac des Chats, 40 square miles in area, Coulonge lake, 25 square miles in area and Pembroke lake, 60 square miles in area, and, above Mattawa, is lake Timiskaming, 115 square miles in area, with Kipawa, 110 square miles in area, and the Quinze-Expanse form a system of reservoirs that can be cheaply controlled. It is greater in extent than all the other lakes in the Ottawa basin put together, and capable, owing to the character of the country, of being raised, not 4 or 5 feet, but 15 or 20 feet.

A stream 100 feet wide and 3 feet deep, running 1 foot per second, or two-thirds of a mile an hour, would fill 1 square mile a foot deep in 24 hours: in other words, 322 c.f.s. will fill or empty a square mile in one day. Now, if a reservoir is 100 square miles in extent and a layer 20 feet in depth is stored on it, there would be 2,000 square mile-feet of storage. This is just about the capacity of each of the three lakes, Timiskaming, Kipawa and Quinze-Expanse, so that, altogether, their storage would amount to 6,000 square miles 1 foot deep. It would take a flow of 18,000 c.f.s. to empty the three reservoirs in 100 days, or a flow of 12,000 c.f.s. to empty them in 150 days—the average low-water period of the river. If we encroach upon the spring flood and allow only a normal flow to pass, these three great reservoirs would be filled up with a reserve supply to be fed out during November, December, January, February and March, and would, thereby, double the present insufficient low-water flow.

This conservation is necessary, not only to augment the winter flow, but also to restrain the flood and prevent unduly strong currents in the navigation scheme. The scheme is, briefly, to dress the river up in convenient reaches by large rock-fill dams provided with sluice openings to pass the flow from basin to basin, locks being provided at each dam. It would be possible to build the dams required at any point as soon as the reservoirs are completed, and offer, in advance of a navigation project, sites for power development with a guaranteed steadiness of flow, and a constant head without ice difficulties.

The river being thus arranged by dams, power would be developed on a general scheme, which could be enlarged to utilize the whole flow at each point in years to come, when transmission may convey to unheard-of distances, and when large blocks of power will be required for heating, for nitrogen fixation, for smelting and for other electro-chemical processes.

The key note of conservation is not only to prevent waste, but also to encourage useful development. Our winters furnish snow, that is, water in the best form for storage, and it is following the trend of nature to create reservoirs for its conservation. The ultimate result will be that the territory from Labrador to Fort William must become a great power centre, and, by improved transmission, distribute power to great distances. Indeed, by the end of the twentieth century, the Ottawa valley may be the power heart of the world and the centre of a delightful district unsullied by coal smoke and beautified by reservoirs of unrivalled natural beauty.

DISCUSSION ON ORGANIZATION.

HON. CLIFFORD SIFTON: We have concluded that portion of our programme which consists in getting information from our friends who are specialists in the various subjects they have discussed. We have now arrived at the point at which we must organize for business and determine the lines upon which we shall proceed. In connection with the organization, one difficulty has presented itself to my mind, and it is a somewhat serious difficulty, but one which, I think, we can overcome. This Commission, of necessity, embraces representatives from all over the country. The statute provides for one regular annual meeting, and it provides also, for other meetings being held upon emergency for particular purposes. It must be obvious that the natural tendency of such a Commission as this would be to make the annual meeting one for the purpose merely of ratifying what the officials had done during the year. Unless that tendency is checked at the outset, that is what it would naturally develop into, and obviously that would be very objectionable. I do not want this movement to be driven by the power of the man who happens to be chairman for the time being. What we want is the moral support of every member of the Commission and of his friends in every section of the country. How can that best be achieved? It would be absurd to think that a commission consisting of twenty-six or twenty-seven men could themselves conduct investigations into all the special subjects entrusted to us. Ordinarily speaking, a commission is efficient in proportion as it is small, but our work must necessarily consist in obtaining as widespread support as possible of the objects we advocate. I make this suggestion for your consideration. It seems to me that the best method of accomplishing our work would be to organize into a number of Committees, dividing the Commission up into committees upon various important branches of natural resources, and appointing one man as chairman of each committee. The result of that would be that the Chairman of the general organization, would be a working executive of the Commission, and we would have a much more effective influence brought to bear in favour of the matters we advocate in that way than in any other. There are various departments, lands, minerals, waters, water-powers, forests, fisheries, public health, and, besides these, we should have a committee to preserve friendly relations with the press and other organizations which may be engaged in doing work of the same kind. For instance, Mr. Kelly Evans is at the head of an organization for the preservation of fish and game in the province of Ontario; while the Canadian Forestry Association has done useful work in furtherance of their objects. These and other organizations we must keep in touch with, and, at the same time, give them to understand that we are not interfering with them, but that we desire to help them in every possible way. We ought to have a committee to ascertain what organizations of that kind there are and in what way they can help us and we can help them. I should like to have your views on this suggestion, and, if there is any other suggestion of a different character, I should like to hear it.

HON. MR. COCHRANE: Do you mean that the sub-committees would investigate and report to a general meeting so that there might be a discussion before any conclusion is reached?

THE CHAIRMAN: That is my idea. We can appoint sub-committees now and, in that way, we will make a beginning and, to some extent, determine on the lines of work. I presume that, with regard to most of the subjects, it would take a committee the best part of a year to ascertain the general development of the subject and determine what could best be done. The sub-committees might be appointed to-day, hold their meetings and take stock of the conditions.

HON. MR. COCHRANE: My idea was to form committees and let them go on with their investigations and have a meeting six months or a year hence, but, if there is any better suggestion, I would be glad to agree to it.

HON. MR. FISHER: If the Committees are formed at once, it would be well for those committees to have a little informal discussion before this meeting of the Commission be concluded; otherwise there would be a danger that no definite action would be decided on during the coming year. We cannot attack everything at once, but there are some things, perhaps, upon which it would be necessary for the committees to have a little preliminary discussion as to what they would take up and ask for immediately, and what they would ask for a little later on. If you appoint the committees this morning, some of them will meet this afternoon and to-morrow morning, and, probably, we might have reports from them for consideration to-morrow afternoon.

THE CHAIRMAN: Is that the wish of the Commission?

MR. HENDRY: The Hon. Mr. Fisher has expressed my views on the matter.

SENATOR EDWARDS: Is it the intention that the central authorities do everything, or will the provinces by themselves take up these matters?

THE CHAIRMAN: We hope that everybody will assist in the work of the Commission. The statute is extremely wide; it gives us power to deal with any question that we may consider to be a question of conservation of natural resources, but, of course, our power is purely advisory. However, inasmuch as Parliament has unanimously constituted this body, we have a right to expect that Parliament will do a good deal towards carrying out our recommendations. If Parliament was serious in constituting such a body as this, then Parliament should be prepared to go a considerable distance to carry out such recommendations as may be made. I think we have every reason to hope, judging by the cordial way in which the matter has been taken up by our friends of the Provincial Governments, that they also, will look with a friendly eye upon such recommendations as may be brought to their attention. Of course, the value of the recommendations will depend upon the care with which the subject is investigated by us. It is our object to co-operate with every government and every body and every association that is engaged in work similar to the work we have in view. There are many branches in which voluntary associations are doing valuable work, and they can assist us and we can assist them. Is the view expressed by Mr. Fisher the view of the meeting?

The meeting expressed assent.

THE CHAIRMAN: I would suggest that we appoint, as we do in the House of Commons, a committee to strike the Committees, and which will report this afternoon at three o'clock. I would suggest that the ex-officio members of the Commission who are here, those who are members of the Federal and local Governments, should act as a committee to strike the Committees.

It was moved by Mr. J. F. Mackay, Toronto, seconded by Hon. Mr. Grimmer, and adopted "That the members of the Dominion and Provincial Governments present, together with Senator Edwards, be a committee to strike Committees on the different subjects."

SENATOR EDWARDS: We have spoken about the conservation of a great many things, but no one has referred to a very important matter—the conservation of property that has been already constructed. Millions and millions of dollars are lost annually, which might be saved if fire-proof buildings were erected. It may be said that the insurance companies make good this loss to individuals, but, after all, it is a waste. I think that industrial establishments,

as well as dwellings, should be constructed to-day so as to mimimize the enormous loss by fire. To give an illustration, the company of which I am president, had a property which was burnt down, and, before it burnt, it cost $19,000 a year to insure it; but, to-day, we have a new fire-proof building, and we can get the same amount of insurance for $600 a year. There is a saving effected in that way, and besides, there is the additional guarantee that it will not burn down again. That property is within a mile of where we are meeting, and if, before we separate, the Commissioners desire to see it, I should be glad to have them come.

Not only is it fire-proof, but it is a property constructed to conserve power. Before we bought that property, the person who owned it was going to put in a steam engine to run the mills. That same property is run to-day by hydraulic machinery, and, after supplying ourselves, we will have 6,000 H.P. to sell. It is a very interesting property, not only to lumbermen, but to all those engaged in industrial pursuits.

THE CHAIRMAN thanked Senator Edwards for the invitation to visit the property.

MR. SNOWBALL: In the different provinces we have natural resources that we do not, to-day, know the value or the extent of. I would suggest that there should also be formed a committee representing the provinces, each with a Chairman, which would hold regular meetings during the year, so that a provincial report, covering the natural resources of each province and the possible means of developing them, may be submitted to the regular meetings of the Commission. For instance, the lumbermen of the whole Dominion, scattered as they are from British Columbia to New Brunswick, might bring in a forestry report dealing generally with the question, but there might be other forestry interests in New Brunswick, for example, that would not be touched upon. I think it would aid us very largely in our annual meetings if we had from the representatives of each province suggestions as to the conservation of the natural resources within that province.

DR. FERNOW: I believe that suggestion to be a good one because, by it, we would be enabled to consider the problems peculiar to each section of the country.

THE CHAIRMAN: We have not decided anything as yet as to what we shall do. I think the suggestion made by Mr. Snowball and by Dr. Fernow is an excellent one, and I do not see how we can successfully hope to do our work unless it is carried out. We must organize a centre for the propaganda of the objects of this Commission in the capital of every province, and it will be a splendid thing if we can get a strong commission in every province to co-operate with us. If that is done, we shall have some hope of doing our work successfully. We must secure the good-will of as many co-operating organizations as we can, and the first part of our duty will be to appoint just such committees.

HON. MR. FISHER: The two main things before us at the present moment are: an inventory of the natural resources of the country, and a spread of our propaganda through the country so as to arouse public opinion along the lines in which we are interested. These are the pressing needs of our work at the moment, and I would like each committee to bear these two things in mind.

THE CHAIRMAN: I would suggest that the Commission adjourn now and that the committees meet and prepare their reports.

The meeting then adjourned.

THURSDAY AFTERNOON—THE COMMITTEES

The Commission met at half-past two o'clock. There was a general and informal discussion as to the best method of organization, and the following committees were formed, after which the meeting adjourned until Friday morning.

FISHERIES.—Hon. F. L. Haszard (Chairman), Hon. Hugh Armstrong, Hon. Frank Cochrane, Hon. Price Ellison, Hon. W. C. H. Grimmer, Hon. A. K. Maclean, Dr. Howard Murray.

FORESTS.—Senator W. C. Edwards (Chairman), Mr. Frank Davison, Dr. B. E. Fernow, Mr. John Hendry, Mgr. J. C. K. Laflamme, Hon. Frank Oliver, Mr. W. B. Snowball, and the ex-officio members of the Commission who represent the various provinces.

LANDS.—Dr. J. W. Robertson (Chairman), Dr. Geo. Bryce, Hon. Sydney Fisher, Hon. Benj. Rogers, Dr. W. J. Rutherford, and the ex-officio members of the Commission who represent the various provinces.

MINERALS.—Dr. H. S. Béland (Chairman), Mr. John Hendry, Dr. Howard Murray, Hon. W. Templeman, and the ex-officio members of the Commission who represent the various provinces.

PRESS AND CO-OPERATING ORGANIZATIONS.—Mr. J. F. MacKay (Chairman), Hon. Jules Allard, Dr. Geo. Bryce, Dr. Howard Murray, Dr. H. M. Tory.

PUBLIC HEALTH.—Mr. E. B. OSLER.—(Chairman), Dr. H. S. Béland, Hon. J. A. Calder, Hon. Sydney Fisher, Sir Sandford Fleming, Dr. Cecil C. Jones.

WATERS AND WATER-POWERS.—Mr. F. D. Monk (Chairman), Hon. Jules Allard, Hon. Frank Cochrane, Hon. Price Ellison, Hon. W. C. H. Grimmer, Mr. C A. McCool.

Moved by Mr. John Hendry, seconded by Mr. C. A. McCool, that the designation of the Committee on Fisheries be changed to read "Committee on Fisheries, Game and Fur-bearing Animals."—Carried.

That the report of the Committee on Resolutions, as read by the Secretary, be adopted.—Carried.

Moved by Senator Edwards, seconded by Mr. Hendry: That the Committee do now adjourn to meet again to-morrow (Friday, Jan. 21st) at 11 o'clock, and that, in the meantime, the Committees meet to consider their recommendations. —Carried.

The Commission then adjourned.

FRIDAY MORNING—REPORTS OF COMMITTEES

The minutes of the last meeting were read and confirmed.

THE CHAIRMAN: I shall now call on the Chairman of the Committee on Forests to present the report of that Committee.

SENATOR EDWARDS presented the report of the Committee on Forests.

COMMITTEE ON FORESTS

Your Committee on Forests begs to report as follows:—

That, through fires originating from various causes, and through reckless cutting by many engaged in lumbering, the forests of Canada have been unduly diminished. That, in view of the general approaching scarcity in the world's supply of lumber, and in view of the rapidly growing needs of Canada for timber for use in the future within our own borders, as well also, as the fact that the maintenance of the forests means the preservation of our water supply, so necessary for domestic use, for navigation, for irrigation and, last, but not least, for motive power, which, through electrical development, is to play so important a part in future industrial and manufacturing operations of all kinds, it is expedient that a policy of forest conservation be entered upon at once. Next to our great agricultural development and conservation, and the conservation of public health, there is no more important matter for the Canadian people than the conservation and perpetuation of our forests. In fact, such is vital to the future well-being of our country.

The question then arises—Can our forests be conserved and perpetuated, and can waste lands denuded of forest growth and unsuited for agricultural purposes be reforested and made a source of value to the State? The answer is—Yes; your Committee believes that such can be accomplished. Other countries, notably France and Germany, have accomplished it, and why not Canada? But the accomplishment of this highly desirable result can be brought about only through the co-operation of the Dominion Government (in whom is vested the ownership of the timber on the public domain of the provinces of Manitoba, Saskatchewan and Alberta, and the unorganized territory) with the various other Provinces of the Dominion and the people of Canada generally.

The three great requisites are: the prevention, in so far as such can be accomplished, of forest fires; systematic cutting on the part of lumbermen, under well-devised and strictly enforced regulations and reforestation of the burned-over areas unsuited for agricultural purposes.

With the object of bringing about the much desired results, your Committee begs to suggest that the first steps to be taken are to ascertain as nearly as such can be done, the quantity of each kind of standing timber in the provinces and unorganized territory, in order to get a reasonable estimate of the annual growth of each and the amount annually cut for domestic use and exportation: and, with the view of endeavouring to bring about uniformity of operation, in so far as conditions will permit, to procure all available statutes and regulations governing the cutting of timber and the prevention of forest fires in the various provinces and unorganized territory. Also we would suggest that the best means possible be taken to ascertain the systems adoptd in France, Germany and other countries for the preservation and perpetuation of their forests and for reforesting areas denuded of forest, in order that your Committee may be placed in the best possible position to recommend the most desirable means of conserving for Canada and its future use one of its most valuable assets.

If the suggestions given in this short report are approved, your Committee will be glad to receive such instructions as will enable it to carry out, in so far as it can be done, what is herein suggested.

All of which is respectfully submitted.

(Sgd.) Wm. C. Edwards, Chairman.

SESSIONAL PAPER No. 52

Discussion on Report of Committee on Forests.

Dr. Bryce: Mr. Chairman, I think the report is very comprehensive, but it leaves out the very important question of afforestation. The third part of the report speaks of regions being burned over, but we have in the West millions of acres that never were in forest. It is all looked at in the report from the standpoint of land that has been under forest. I am not objecting to the report, but it would seem that there was an omission there.

Senator Edwards: We could amend the report by simply adding a sentence regarding afforestation in such prairie sections.

Hon. Mr. Fisher: The immediate actual suggestion is to ensure an inventory of practically all our present forest wealth. I think that it is one of the most important works that we can undertake. I did not understand, however, that the Committee made any suggestion as to how that can be done. It is a pretty difficult undertaking and I do not know at present how it can be done unless we simply take the reports of the different forestry departments. That is not sufficient. Somebody will have to do more than that in the near future and I would ask for a little discussion as to how steps may be taken to obtain a more accurate inventory of our forest wealth.

Senator Edwards: The same idea occurred to the Committee, but we thought that perhaps it would be going a little too far; that that question was one which involved ways and means and that we could not very well suggest how it should be done. The Committee also were of the opinion that working out anything of that kind would take some little time. I agree with the Minister of Agriculture that the present information is not at all sufficient, and, if the various provinces and the Dominion on its part, having regard to the lands over which it has jurisdiction, would take up that question of getting accurate information, it would be a great advantage. But again, I say, it involves ways and means and, to do it accurately would involve a great deal of work. I think it could be done without involving very great expense. For instance, take Ontario; they think that they have a pretty good idea to-day of what timber they have, but, I think, in New Brunswick, the information is not at all complete. In Quebec, too, there are cursory surveys and estimates, but they are not at all sufficient. As to the other provinces, I cannot speak. I do think, and agree most thoroughly with the Minister of Agriculture, that there is nothing more important than that one thing of finding out just what we have got and where we stand, but, as I have said, it involves ways and means.

Mr. Hendry: So far as British Columbia is concerned, we have a large territory, but we have a certain amount of information regarding our forest resources. A Commission was appointed a year ago by the Provincial Government, of which, Mr. Goodeve, who is here, is a member, and Mr. Goodeve will be able to give a great deal of information. Of course, there is a great extent of country that has not yet been gone over. That will take some time. There is no doubt that, as far as we have gone, we will be able to give in reference to the country that has been explored, a great deal of the information which we are now looking for. The Dominion Government owns a considerable part of the lands in British Columbia, having obtained them for railway purposes. Besides, they have some three and a half million acres in the Peace River country, which, of course, they will administer. They have already been administering the fire protection jointly with the Province; that is, so far as anything has been done

in that direction. I think we will be able to get a great deal of information from the Provincial Government which will be of assistance. Mr. Goodeve can explain better than I can, as he is a member of the local Commission on Forestry in British Columbia.

Mr. Snowball: I am very much pleased to hear the Minister of Agriculture bring up this matter of tabulating natural resources, especially when we consider that it will involve a considerable expense for the Dominion to secure such an inventory. I rather inferred from what I read in the newspapers that his Department will be the one responsible for the raising of the finances necessary to carry on this work. I see he has at once grasped what is needed of the Commissioners and, having grasped it, I am more confident in the hope that we shall be able to get the funds necessary to find out what the natural resources of our country are.

In New Brunswick the Provincial Government has, I think I can say, a fairly accurate, if not absolutely definite, knowledge of what timber exists on their Crown lands. They have never had a full report on the lands in the Province and have to depend very largely on the holders of leases for the information they get respecting the timber on the lands under lease. A large amount of land in that Province was given away years ago to railway companies, and we would have to depend on information supplied by these corporations unless we are prepared to spend a large amount of money to make a full survey of the province of New Brunswick. However, I think a cursory survey, one that is not so very full, can be made for that Province; and, if the Commission should recommend that some assistance should be given to the several Provinces towards a survey to find out what the natural resources are, not only those they know of, but others that may exist of which they are unaware, it would be a very good thing and an expenditure well made on the part of the Dominion.

It may be contended that it is the provinces who will benefit. That is true to a very large extent, but any assets discovered within any province of the Dominion benefits the whole Dominion and are assets of the whole Dominion as much as of any province. I have had doubts, and I brought the matter up in the Committee in order to find out how great an expenditure we, as a Committee of this Commission, should suggest that the Government make for a forest survey. Other Committees, no doubt, will make suggestions along similar lines and, if the Government saw fit, a general suggestion could be made of the same kind that the provinces should investigate the forests, mines and other resources at the same time, and thus bring in at a very early date, their reports of what the real resources are.

Referring to fires, that is something we should deal with before the Commission meets again. In New Brunswick the Intercolonial, a Government railway, passes right through the Province from north to south, coming in at Campbellton and going out at the southern border into Nova Scotia. Then it runs from St. John through to Shediac and from Miramichi through to Fredericton. Those who are familiar with the Province will at once see that the Intercolonial passes through great timber areas that are of great value to the Province and to the Dominion. That Government railway is the only work that does not come under the general laws of the Province so far as fire guardianship is concerned, and the great devastating fires that we have had in the province of New Brunswick have been along the line of the Intercolonial. What should be done by the Chairman and this Commission is to exert their influence on the Government in order to secure immediate legislation whereby the Intercolonial railway will have to conform with the laws of the several Provinces, so far as fire guardianship is concerned. That is an important subject in the province of New Brunswick, one

on which I think this Commission will feel it its duty to see that some action is taken at this session of Parliament, or some promise given by the Intercolonial Commission that they will co-operate with the Crown Lands Department of New Brunswick to assist in watching their road, as far as possible, cleaning up the right-of-way and having fire wardens on duty in the dry season, so that fire will not devastate the area through which the road passes.

THE CHAIRMAN: That does not apply to the Intercolonial railway alone. There does not appear to be any excuse for this exemption of the railways. They are practically free from any control in regard to fire.

HON. MR. GRIMMER: The Commissioners last year, in correspondence with me, finally stated that they would conduct the Intercolonial railway under the Railway Act of Canada.

In connection with the suggestion for the electrification of the National Transcontinental railway through Quebec and New Brunswick, the preservation of standing timber is an important consideration. The line runs through 800 miles of the province of Quebec and 259 miles of the province of New Brunswick. Eighty-nine miles of that 259 is Crown land, where, in many cases, the axe has never yet been put to a tree. The virgin growth of forest is there, magnificent timber, lumber of the best kind and highest class. Another portion of it runs through lands owned by the New Brunswick Railway Co., which were given away, as Mr. Snowball said, years ago by the Province. These are magnificent timber lands, lumber of untold wealth is there; and, unless the road can be electrified, or some stringent measures are laid down whereby fire will be prevented, that whole country will burn up. If I had a map of the Province here and could show you just how that railway runs through the counties of Restigouche and Northumberland, you would at once see how fires starting out from the right-of-way of the National Transcontinental railway would destroy all that is left of the valuable timber lands of New Brunswick. I wish to say in this connection that the Commissioners of the National Transcontinental railway and the Dominion Government have assisted and are doing very well in the prevention of fires during the construction of the road. We suffered to some extent this year by a fire which started on the right-of-way. Last year we had practically no fires at all. The Dominion Government appointed 45 or 46 fire wardens. The only complaint I have to make in connection with that is, in some cases, with regard to the selections of men that were made. However, they appointed the men and the Provincial Government clothed them with all the authority of fire wardens under our Provincial Act and we swore them in as fire wardens so that they had full power to arrest without warrant, any person found violating the fire law. Last year, this arrangement worked satisfactorily and there was no fire to amount to anything along the right-of-way, but this year, a fire did get away and ran about twenty miles by seven in the Province through Crown lands, fortunately not through a valuable tract. It was quite a serious fire, but it was coped with, and we have reason to congratulate ourselves on the result so far. Last spring, from May until July, we had absolutely dry weather down there, no rain at all. The year before the fires occurred in the fall of the year. The spring fires are not, as a rule, so dangerous to the forests, as they are what we call leaf fires, while the fall fires are soil fires. The leaf fire will run through the woods and, while it destroys a lot of timber, it does not have the same effect as a fire in the fall because that not only takes the leaves and wood, but it takes the soil as well and burns down five feet, so that for a thousand years nothing will grow on that land. Look at the line of the Intercolonial railway from Chatham to Fredericton. For miles and miles after you leave Chatham June-

tion you can see the splendid timber of our Province cross-piled and burned where it has been ruined by fire, the soil burnt out, the timber being blown over by the first strong wind that blows. The next wood that comes on, if there is any soil left, is the white and grey birch, which is useful for firewood, but for nothing else, although you can make spools of the white birch. Those valuable lands have been entirely denuded. Whatever may be said as to the National Transcontinental railway, I do feel that we in New Brunswick have a grievance so far as the Intercolonial railway is concerned. The Intercolonial railway line from Fredericton to Chatham is a hard road, the grades are heavy, and the result is that the engineers could not make time with their trains if they had the proper hoods on their smokestacks. The result is that the hoods are taken off.

In May last, Honourable Mr Burchell, a member of the Legislature of New Brunswick, telephoned me that there were three fires on the line between Fredericton and Chatham junction in one afternoon. If we had not had fire wardens there and taken immediate steps to check the fires, there would have been a great conflagration. When I asked the Intercolonial Railway Commission to give me transportation for some of our fire wardens, the chief men whose duty it is to fight the fires, they absolutely refused to give transportation for two men over the Intercolonial railway. Mr. Butler said, in replying to me, that he would not do it because they were being asked every day for transportation for Provincial officials. No Provincial official, no head of a department, asked for transportation, except for the two men for whom I applied, and they did not get it. Yet these wardens had to go. The telephones are used everywhere, and, when a fire starts in a certain district, a warden is notified and he gets there as quickly as possible and fights the fire. We feel that we need some protection, and when we go to the Intercolonial Railway management in an effort to improve the conditions, they say they will manage the railway under the Railway Act of Canada. We cannot put ourselves up in conflict with the Dominion authorities in respect to the Intercolonial Railway, but we feel there is so much involved in this matter of forest fires that there should be no question, as far as railways are concerned. If they do not wish to do anything else, they should at least clean up the right-of-way. If the right-of-way is not broad enough, we will consent to its being widened. Then let them clean out all stumps and stones and plough it up next to the forest land, so that sparks cannot do damage. But that right-of-way is not cleaned up and no attempt is made to clean it as other railways do. I called upon the Canadian Pacific Railway, the Grand Southern and other railways, and they all sent crews out and burned off their rights of way. Sometimes a fire of that kind gets away from the men, but then the railway company is responsible for the damage. They make an effort to comply with the law. I am not sure about the appliances on their engines, but they clean out the right-of-way.

In addition, we want to cultivate and educate sentiment in respect to sportsmen, fishermen and others going into the woods, particularly in the spring. This applies to all parts of the Dominion. There is no other source so prolific of forest fires as this. We had sixty-six reported in New Brunswick this year, and of these, ten or fifteen were started by fishermen. It is a pretty hard thing to say that men shall not go in to fish in your streams, especially when you have good sport to offer them, but the majority of these men are absolutely careless, having nothing in view but the day's sport, what they are going to bring back and the size of the fish they will be able to tell about in the newspapers. They will boil a kettle against an old stump. There is nothing more fatal than that They build a fire against an old pine stump because they find it sends back a splendid heat, but in many cases they do not take the pains to carry water and put the fire out.

MR. MACLEAN: Do you issue a license?

HON. MR. GRIMMER: We do not yet. If the provinces all joined together in doing this, it would be a benefit to the whole of Canada.

What I want particularly to impress upon the Commission is the absolute necessity of doing something to control this railway situation and make the railways, particularly the Intercolonial Railway, feel that they must recognize the Provincial laws so far as fire protection is concerned; because there is nothing but a waste all along the line of the Intercolonial Railway in the province of New Brunswick. I do not care what part of the road you are on, you ride through a barren waste, and, for generations to come, there will be no more timber on these lands unless they are reforested.

DR. FERNOW: I would like to accentuate the position taken by Mr. Grimmer. Here is a subject that can be taken in hand by the Commission without further planning. The rest of the recommendations, I feel, with the Minister of Agriculture, are rather in the air, are rather indefinite. Methods of procedure have not been proposed. We could probably have all the information that is in existence collated by some clerks in the office, but it is quite correct that this information is not sufficient. The task of taking stock of our natural resources in timber alone is an enormous one, a greater task than is, perhaps, realized, even if we only wish to have approximations; and, as for exactness, you might just as well strike that word out of your dictionary in so far as it applies to resources.

Some things the Committee asked are absolutely impossible to secure. The rate of growth is something which every forester would like to see answered, but it is almost impossible to ascertain it. It can only be guessed at.

There are propositions here that would take a lifetime to ascertain, and so I would suggest that the Committee be at once instructed to furnish an extensive report on the methods of fighting forest fires. As we have seen, various conditions require different methods; the provinces present conditions more or less unlike, and the methods must be varied. I think we too often generalize from short experience. We could, however, have a thorough investigation of the methods in existence and form a judgment as to where their application would be desirable. That could be done in a very short time, while the taking of stock, generally, of the standing timber would last a lifetime and involve a great expense. I have some opinions as to the methods to be pursued in reference to that, which include a personal canvass from province to province, and that brings me back to the original proposition to have the Commission further organized so as to have Provincial Committees, all meeting in the separate provinces and arranging a comprehensive plan so that some subjects can be attacked at once, like this question of forest fire protection.

MR. GOODEVE: I would like to say a word endorsing what has been said regarding destruction by forest fires. Our Commission in British Columbia has spent several months taking evidence and collecting data in regard to the various features of our timber resources. The matter mentioned by Mr. Grimmer in regard to the starting of fires by sportsmen, we have found little difficulty in controlling. We have amended our laws in this particular and have issued a large number of extracts from the law, printed on linen. The fire wardens take these and place them on the various trails and the places of ingress to the different districts, and the sportsmen are all warned. Furthermore, no settler is allowed to set out a fire in a timber district without first getting a permit from the fire warden. Timber men and others are now asking that no permit be

granted for the three months of summer—June, July and August—under any conditions, and the Commissioner of Lands has that under his consideration. We find that this has greatly increased the protection, and public opinion has kept the number of fires due to sportsmen almost at a minimum.

Coming to railways, the evidence before the Commission bears out what the previous speakers have said. A very large proportion of the fires are caused by railways. It is important to bear in mind that there are conditions, in that connection, even with the railways. In my Province the grades in some districts, particularly the timber districts, are heavy. I have been on trains that were stalled going up these grades and that had to wait to get up steam. The result of that is that, while the Railway Commission has laid down certain rules and regulations regarding fire appliances on engines and fire-boxes, there is a great temptation for the engineer and his fireman, when they find it nearly impossible to carry the train, to keep steam up in some way; on many occasions either to remove the fire screen altogether or, as shown in some evidence, to break through it, run a bar through it in order to get a draught. That, in some cases, becomes a great temptation. It is difficult to say just how far the Commission can go in making these mechanical restrictions. Moreover, they would have to be carefully worded. The very suggestion that was made by the Chairman has been made to the railroads, viz., that they should have an electric or gasoline track motor equipped with a hose and carrying a supply of water, with which they could follow up at regular intervals, trains going through valuable timber or have a telephone line along the telegraph line, so that a warden could telephone to a fire station and have this truck go to the scene of the fire. Of course, they demurred at the expense; but we must consider that, while nothing unfair should be done, they—the railroads—must be made to feel their responsibility.

The clearing of the right-of-way has been largely successful. The débris is left in many places; it dries in the hot summer and simply forms tinder for a large percentage of fires that come from the railways. Two of the most practical suggestions that have been put forward are, that the rights-of-way should be cleared and that the railways should be held directly responsible for fires caused by them, thus not placing on the average man the whole onus of fighting a great railway corporation. It is nearly impossible to do this. We did carry one case against the Great Northern to the Privy Council and got a verdict of $22,000 and all costs. It was a long, hard fight; but they had taken the number of the engine, knew when the fire occurred, how it occurred, and where it went to.

The Chairman: The destruction of forests by fire is a large question affecting every province, not only as regards its interests, but as regards the interests of the whole country. We ought to have a distinct, clear and definite resolution on the subject which would authorize the Chairmen of the Committees, along with myself, to make the strongest representations on the subject to the Government. I have had to do with railway companies for twenty-five years and there is one thing you can be pretty sure of: just as soon as the law makes them responsible for anything, they will attend to it. So long as the law does not make them responsible they will not pay any attention to it. I have never been able to work out the principle on which we permit railways to go through the country spreading destruction. We do not allow anyone else to do that, and why we should permit the railways to do so, I cannot understand. For my part, I would be prepared to support the strongest possible resolution urging the Government to make the laws such that the railways will be primarily responsible. As to the Intercolonial Railway, my own opinion is that it should be in the same position as any private corporation.

MR. DAVISON: As far as conservation is concerned, it is burlesque to put in our time talking about it while the railways are allowed to burn the country from Nova Scotia to British Columbia. If the destruction caused by them is not stopped, it is nonsense to attempt to conserve what we have.

Mr. Snowball suggested a resolution dealing with fires along Dominion railways.

THE CHAIRMAN: The words "Dominion railways" are subject to two interpretations. They mean either railways owned or operated by the Dominion Government, or railways operated under a Dominion charter.

HON. MR. FISHER: I think we ought first to recommend an amendment to the Railway Act which will make the railways responsible for the damages resulting from fires caused by them. Then, the question of the Intercolonial Railway is a separate one.

MR. SNOWBALL: I shall redraft my resolution, if I may, and present it later in the proceedings.

DR. FERNOW: I would like to introduce another resolution as follows:

That the Committee on Forests be instructed to prepare, as soon as practicable, a comprehensive report on the methods of fighting forest fires, in existence in this country and elsewhere.—Carried.

THE CHAIRMAN: I suggest that this resolution should be brought in with Mr. Snowball's at the close of the discussion.

HON. MR. FISHER: These are two totally different subjects.

SENATOR EDWARDS: My judgment is that the suggestion in the report is the best. What this Commission is trying to arrive at, is to try and devise the best suggestion that can be recommended to the whole Dominion for the prevention of these fires, and what we have asked for is to obtain from the various provinces their existing laws and regulations in that respect in order that we may arrive at some conclusion to suggest to them all the best means to adopt. To proceed at once, I think, would be going too fast. I think it is all right to amend the Act so far as railways are concerned. I think the best suggestion came from Mr. Maclean yesterday. What is the use of our suggesting something to-day when the various provinces have existing regulations and laws? Let us get them together and, out of the whole, construct a scheme that we think is the best, and ask them to apply the suggestions we make. I think the provinces may say, if we offer suggestions to them, that we are going too fast.

DR. FERNOW: This resolution does not suggest anything to anyone; it simply proposes to bring together the information we possess, so that anyone who wishes can choose what, in his particular locality, is applicable. I believe it is within the scope of the duties of the Committee to make reports, but I propose, instead of waiting for reports on all the subjects, to take up this important subject immediately and to secure the information that we can secure with no great difficulty.

HON. MR. HASZARD: It appears to me that, if we undertake too much just at this moment, we may lose the whole. I believe, if we could adhere to the first

recommendation, that is, not only to impress but to insist, as far as possible, upon the Government so amending the Railway Act as to bring the Government-owned railways under the provisions of the various laws of the provinces which necessitate their protecting their own lines and protecting the public lands as well, it is about all we should undertake at this moment. There is no doubt that there is a great deal to be done along the other line suggested, but I think that, if we limit the resolution at present, to asking for the one practical amendment so as to bring the Government-owned railways within the provisions of the law, it would be about all we should undertake now.

THE CHAIRMAN: The principle applies to railways chartered by the Dominion as well as to the Intercolonial Railway.

DR. MURRAY: I cannot see the objection to the resolution of Dr. Fernow. It seems to me to provide simply for collecting information from the different provinces and the formulation of a scheme.

SENATOR EDWARDS: That is what the report is.

DR. MURRAY: To my mind, the wording of the resolution makes it clear that all that is suggested is the collecting of the plans of the different provinces. I have much pleasure in supporting the resolution.

DR. FERNOW: It deals with but the one subject which is also dealt with by the report. It will be the first duty of the Committee to report on this subject, and the information can be secured without difficulty.

The resolution was adopted.

On the motion of Hon. A. K. Maclean the report was adopted.

COMMITTEE ON FISHERIES, GAME AND FUR-BEARING ANIMALS.

THE CHAIRMAN: I shall now call upon the Chairman of the Fisheries Committee to present his report.

HON. MR. HASZARD: Owing to the fact that members of our Committee are on several other committees, we have found it impossible to discuss anything in connection with fisheries. The question being such a large one, and so many diversified interests being involved, we came to the conclusion that it was really impossible to consider it, and I agreed to tender a formal report saying we were not able to deal with the matter. Since this report was made, a communication has been handed to me from British Columbia regarding the salmon fisheries there and asking very urgently that steps be taken for the protection of those fisheries and declaring that, unless something is done immediately, the extinction of that very valuable fishery will take place within a short time. So far as I can see from the letters we have received, there is quite an international question involved that must come up if we are to deal with this matter. It is in regard to the run of the fish. They say that in Puget sound, where the fish have to pass up the Fraser river to the spawning ground, they are being taken in immense quantities on the American side. Of course, it would be difficult to know what any Commission could do in such a matter.

THE CHAIRMAN: We have heard that matter discussed for many years.

Hon. Mr. Haszard: Yes, I mentioned it to show that this question will require a great deal of consideration and time. In the Maritime Provinces the lobster and oyster fisheries are the two very essential fisheries that require the attention of this Commission, but these are subjects that will take a great deal of time.

I beg to submit the formal report of the Fisheries Committee:—

Your Committee beg to report that, within the short time at their disposal, it was impossible to obtain any information on the subject of this enquiry which would be of practical use, and that it will take much time and involve much enquiry, as well as a considerable expenditure of money, before a report can be made.

(Sgd.) F. L. Haszard, Chairman.

On the motion of Hon. Mr. Grimmer, seconded by Hon. Senator Edwards, this report was adopted.

COMMITTEE OF MINERALS.

The Chairman: I shall now call upon the Chairman of the Committee on Minerals.

Dr. Beland: Mr. Chairman, as in the case of the Committee on Fisheries, we have found it almost impossible to submit to the Commission any important recommendation, for the same reason, viz., that an enormous amount of technical information was necessary but was not readily available to the members of the Committee. Our report leaves almost entirely in the hands of the Commission what is to be done. When the Committee sat yesterday, I took upon myself to call upon Dr. Haanel, of the Mines Branch, to give us some advice.

The doctor was kind enough to come over, but he was not ready to advise the members on such short notice. This morning, however, he submitted to us some recommendations which the Committee did not care to adopt, but decided to submit to you for consideration. I beg to submit the report of the Committee and also the recommendations of Dr. Haanel:—

Your Committee beg to report that it is deemed desirable to obtain at once, a compilation of statistics relative to the known mineral resources of Canada, the annual production of minerals in each province or in any territory, and any other information which would aid the Commission to accomplish its end; and that financial provision be made for the same.

Your Committee further suggests that steps be taken to secure legislation to make it imperative upon mining companies to supply the Government with a yearly report of their output and the estimated value thereof, in order to render our statistics more accurate.

(Sgd.) Henri S. Béland, Chairman.

Dr. Haanel's Recommendations

The following recommendations were submitted to the Committee on Minerals, at their request, by Dr. Eugène Haanel:—

First: the appointment of two competent mining engineers to make an inventory of our mineral resources so far as known, and to map their locations.

To one of these officers are to be assigned the metalliferous deposits; to the other, the non-metallic deposits. Since this class of work is evidently more or less continuous, I recommend that this work be done by two officers permanently appointed on the staff of the Mines Branch.

Second: the early appointment on the staff of the Mines Branch of a thoroughly competent metallurgist, whose duty it shall be to report upon metallurgical processes practised in Canada, to render himself conversant with all new developments in metallurgical methods on this continent and abroad, to report upon the same and to recommend for special investigation such of these processes as would tend to a more economical treatment of our ores.

Third: the passing by Parliament of an act for regulating the use of explosives, for establishing a testing station for the investigation of all explosives now in use in Canada, for the purpose of eliminating and rendering illegal the use of those explosives which, on test and in practice, have proven to be dangerous; and for regulating the manufacture of explosives in Canada.

Fourth: as the Act creating a Department of Mines assigns to the Mines Branch the duty of collecting statistics for mineral production, and as, at present, the Mines Branch has no power to compel mine owners and owners of metallurgical plants to furnish this information, but is at the mercy of the good-will of mine owners and owners of metallurgical plants for their returns, it is recommended that a Bill or an amendment to the Mines Act be passed by Parliament to render returns of the mineral production by mine owners and owners of metallurgical plants compulsory.

THE CHAIRMAN: The Committee has been very judicious in submitting Dr. Haanel's recommendations as they have done. They can be considered later.

The report was adopted.

COMMITTEE ON WATERS AND WATER-POWERS

THE CHAIRMAN: I shall now call for the report of the Committee on Waters and Water-powers.

In the absence of Mr. F. D. Monk, the Chairman, the report of this Committee was presented by Mr. C. A. McCool.

The report read as follows:—

Your Committee recommends:

That steps be taken to obtain and tabulate complete information on the subject of the waterways of Canada so far as available information goes, and, wherever practicable, that such information be supplemented by examination and inspection.

That this information comprise statements of the development of powers which have taken place, their scope and the market therefor, the amount used by the public and the rates charged.

That, for the use of the Committee on Public Health, information should also be collected showing how, and to what extent, the water-courses are being contaminated by drainage.

Your Committee further recommends:

That the Commission should, by resolution, declare that, in its opinion, there should be, in future, no unconditional titles given to water-powers, but that every grant or lease of powers should be subject to the following, among other conditions:

1. Development within a specified time.
2. Public control of rates.
3. A rental with the power to revise same at later periods.

The report was adopted.

COMMITTEE ON LANDS

THE CHAIRMAN: I call on the Chairman of the Committee on Lands to present his report.

DR. ROBERTSON: The Committee on Lands reports as follows:

Your Committee, having given consideration to the department of natural resources with which it is to deal, begs to present, as an interim report, an outline of work which it proposes to take up for the current year.

FIRST DIVISION.

First: the collection and arrangement of available statistical information as to areas of agricultural lands, occupied and unoccupied, surveyed and unsurveyed.

Second: the collection of information as to soil areas, classified as to their characteristic contents, such as clay, loam, sandy or other formation.

Third: the collection of information for a classification of areas devoted to particular crops, particularly in regard to (a) soil formation, (b) climatic conditions.

Fourth: the collection of information by investigations and the testimony of farmers and others, (a) as to whether agricultural lands are being depleted of the elements of fertility, or are being improved in that respect, and (b) as to the dangerous prevalence of weeds and other hindrances to their crop producing power.

Fifth: the collection of reasonably complete information as to the extent, character and availability of natural fertilizers, such as phosphates, mussel muds, mucks, etc.

Sixth: a preliminary study of water supplies on farms for domestic and supplementary irrigation purposes, and a preliminary study of fuels and other natural sources of heat, power and light on farms.

SECOND DIVISION.

The carrying on of a campaign for the dissemination of information regarding the conservation of resources, particularly by a series of meetings in each province in co-operation with members of the Commission in the several provinces respectively.

Your Committee estimates that about thirty meetings would be required to cover the Dominion in a fairly adequate manner during the year.

THIRD DIVISION.

Your Committee is of opinion that a sum of money should be provided sufficient to meet the outlay necesssary for carrying out the work which is herein recommended and would suggest that the Chairman of the Committee take up

the matter with the Chairman of the Commission and a provisional finance committee, if such be constituted.

All of which is respectfully submitted.

(Sgd.) Jas. W. Robertson, Chairman.

The report was adopted.

COMMITTEE ON PRESS AND CO-OPERATING ORGANIZATIONS.

THE CHAIRMAN: We shall now have the report of the Committee on Press and Allied Organizations.

Mr. Mackay read the report as follows:—

The Committee on "Press and Allied Organizations" begs to report as follows:—

In our opinion, it will not be possible to accomplish much of a definite nature in the way of creating public opinion until such time as the other Committees have done something tangible, as we take it that our duties will largely begin where those of the other committees end. As a beginning, however, we would recommend:—

First: that the comprehensive and illuminating address of the Chairman of the Commission, Hon. Clifford Sifton, delivered at the first session of the meeting, be circulated in the widest manner possible, both in English and French, and that, to this end, the Secretary be instructed to communicate with every daily and weekly newspaper in Canada offering to supply, free of charge, the address in the form of a supplement in sufficient quantities to cover the circulations of the respective papers.

Second: that the Secretary be authorized to make arrangements for the issue of bulletins, either weekly or monthly, for the use of the press of the country, after the various publishers have signified their desire to receive the bulletins; these bulletins to consist of short, pithy paragraphs and reports dealing with the various phases of the Commission's work, and that, until such time as the other Committees have made such progress as is deemed desirable to make public, these bulletins be prepared largely from the papers read at this meeting.

Third: that in addition to the publicity which, it is hoped, will be secured through the press, efforts be made to utilize the public platform in the most effective manner possible. This, your Committee thinks, can best be done, for the time being, by the members of the Commission in their respective provinces arranging meetings in leading centres, the addresses to be made by such persons as the Commission at headquarters might from time to time be able to secure.

Fourth: that the widest publicity possible be given to the fact that it is the Commission's earnest wish to act in hearty co-operation with every organization having for its object the conserving and building up of any portion of the Dominion of Canada, and that, with this object in view, the Secretary be asked to communicate with the following bodies, and with such others as may from time to time be deemed advisable:—The Canadian Press Association, the Maritime Provinces Press Association, the Quebec Press Association, the Eastern Townships Press Association, the Western Canada Press Association, the British

Columbia Press Association, the Fish and Game Protective Associations in Canada, the Canadian Forestry Association, the Canadian Clubs, the farmers' organizations of the various provinces, the Canadian Manufacturers' Association, the Trades and Labour Federation of Canada and the various Anti-tuberculosis Associations.

Fifth: that the report of this conference be issued without delay, in convenient form and in large quantities.

Sixth: We would humbly suggest a change in the name of the Committee from that of "Press and Allied Organizations" to that of "Press and Co-operating Organizations."

Lastly, we would express satisfaction that the appointment has been made to the headquarters' staff, of an experienced journalist, whose duties it will be to collect, edit and disseminate in proper form all information furthering the work which the Commission may, from time to time, have in hand.

All of which is respectfully submitted.

(Sgd.) J. F. Mackay, Chairman.

DISCUSSION ON REPORT OF PRESS COMMITTEE.

MR. MACKAY: The Chairman's address may be secured in the form of a supplement at the rate of $2 a thousand. Supposing 200,000 copies are asked for by the newspapers, that would represent an expenditure of $400, and the Committee thought the Dominion Government has never invested $400 to better advantage than it would in offering to give this address, free of charge, to newspapers. The address would be inserted in the newspapers and circulated.

DR. RUTHERFORD: If we could get this address before the teachers and, through them, before the pupils, it would be the most effective way of giving publicity to it. We might distribute it through the inspectors and the school journals.

MR. MACKAY: The teachers' associations might be useful. It is very important to get it into the hands of the pupils.

HON. MR. HASZARD: We might send it to the Departments of Education and let them circulate it among the teachers.

DR. RUTHERFORD: There are only 30,000 teachers in Canada.

THE CHARMAN: I have no objection to the report, except the first recommendation. I do not see why we should discriminate between the different papers that have been presented. For instance, I do not see why we should circulate more copies of my address than of Mr. Beck's very valuable paper on the work of the Hydro-Electric Commission. I have heard a great deal about the power policy of the Ontario Government, but I never heard it thoroughly explained before. Why should we not circulate an equal number of all the addresses in our reports?

Mr. Mackay: The Committee felt that that was the basis of the whole work of the Commission, and that it was essential we should circulate a large number of copies of it.

The report was adopted.

COMMITTEE ON PUBLIC HEALTH.

The Chairman: May we have the report of the Committee on Public Health?

Senator Edwards: Before leaving, Mr. Osler told me that it was absolutely impossible for him to make a report in the time allowed, even if he had been here.

Hon. Mr. Fisher: Mr. Osler told me yesterday that he suggested, as the first action, that that Committee should communicate with the health authorities of each of the provinces, and that, when he got the information at their command, he was going to call a meeting of the Committee which would discuss it and take action.

Mr. Snowball's resolution as re-drafted was then adopted. It was as follows:—

That it is important that steps be taken at once by this Commission to protect the forests from fire, especially along the line of railways, and

That, in particular, legislation be recommended by this Commission to bring the Dominion Government railways under the fire laws of the several provinces through which they pass, and

That Government railways should also be made liable for damage done by fire originating from their engines, and

That the burden of disproof should be on the railways; also

That the legislation provide for the transportation by all railways of the chief district fire rangers and fire wardens, free of charge, when on their way to investigate or fight fires along their line of railway.

Carried.

Mr. Snowball: I still think it is necessary to have some organization in the different provinces, with a chairman for each province, if we intend to record as much work as we would like at the next meeting of the Commission. It would be very beneficial if the provinces or groups of provinces were organized, each with a chairman, who would have authority to call together that Committee for the discussion of the broad subject of the different natural resources of the province, and we would be much better prepared than with committees from all the provinces, which probably could not meet within the year. If the chairmen of the provinces had the power, as members of the executive with yourself, to certify travelling expenses in connection with these meetings, it would be very helpful.

I would move that we discuss how to organize the provinces to the best advantage, as well as having committees on the different resources.

The Chairman: There is a point in connection with that. We have organized a number of Committees to deal with certain subjects. Would it be well to

have committees in the provinces acting independently of these committees? The Committees should find out first where we are on these different subjects. We must know what we intend to do before we start out to do it. So, while it appears that we must have organization of the kind Mr. Snowball suggests—for that is the whole object, to influence the public mind on the subject and get the governments to move—we ought first to get a definite programme laid out by our Committees, and then, when we form an organization in a province, the Chairman will be able to say what the organization has been formed to do.

GENERAL DISCUSSION.

THE CHAIRMAN: What is the view of the Commission as to the next meeting? The view was expressed yesterday that the Committees should do their preliminary work and have a meeting of the Commission fairly soon, not waiting for the next annual meeting.

MR. HENDRY: What is "fairly soon?"

THE CHAIRMAN: Yesterday it was suggested within the next three months, after the Committees have had a chance to get into operation.

DR. BRYCE: June is suggested.

HON. MR. FISHER: I do not think we can make sufficient progress to report much by June. I would suggest about the first of October.

THE CHAIRMAN: People go away on their summer holidays. They return to their business and are busy for some time after the 1st of September. I think it would be better if we could have the meeting in the spring.

MR. MACKAY: And the exhibitions are held in the fall. I would move that the Commission meet in either Toronto or Quebec in June.

SENATOR EDWARDS: So far as the Committee on Forests is concerned, we will not have much to report then.

THE CHAIRMAN: You will have to work a little harder, that is all. I think we had better have it some time about June.

DR. BRYCE: The second week in June.

DR. BELAND: Are the Committees going to meet in the recess?

MR. HENDRY: The meeting will be of general importance. I think it should be held in Ottawa at the general offices of the Commission. This is a more central point. Then, when we get the provincial organizations, we may have meetings at Quebec or anywhere. I understand the meeting is, to a certain extent, for the purpose of bringing together our findings.

DR. ROBERTSON: I would suggest some time in the first half of July. There are on the Commission representatives of all the Universities, and these men cannot get away about the first week in June. Personally, I shall be abroad and shall not be back before July. I shall, while abroad, try to get a good deal of information of value as to methods in European countries, such as Switzerland.

DR. BRYCE: The Universities are all closed by the first of June. The convocations are over by the second week in June.

MR. MACKAY: I move that we meet in the second week in June.

DR. ROBERTSON: I move in amendment that we meet in the first half of July.

The amendment was negatived.

Mr. Mackay's motion was agreed to.

After further discussion, the place of meeting was left to be settled by the Chairman after consultation with the Prime Minister.

HON. MR. HASZARD: Dr. Robertson will visit the old country in the spring, and I think that, when he is going, probably it would be as well to give him the authority of this Commission to make enquiry on our behalf as to methods that prevail in other countries respecting the conservation of natural resources. If he was armed with this authority, it would probably place him in a better position to make enquiries than if he was simply acting on his own behalf. I therefore move:

That the Chairman of the Committee on Lands, Dr. J. W. Robertson, be authorized and directed to make enquiry and investigation in the various countries which he visits while abroad as to the methods which prevail there for the conservation of natural resources.

In moving this resolution, I think it is well to authorize Dr. Robertson to make these investigations, especially as I know that these enquiries can be made, and will be made, without any expense to the Commission.

DR. BRYCE: I have great pleasure in seconding this resolution. We discussed it in the Committee, but thought it better to have it dealt with by the Commission.

DR. FERNOW: I have arranged passage to Sweden and would be glad to have similar authorization to enquire there as to methods employed.

MR. DAVISON: I have great pleasure in moving to amend the motion by providing that Professor Fernow be granted the same authority from the Commission.

The motion, as amended, was agreed to.

THE CHAIRMAN: We now come to the question of funds. This is a very important phase of our work. My view is that, as Parliament has taken the responsibility of passing the Act which constitutes this Commission, it is presumable that it was in earnest. I presume that it did not mean that gentlemen representing all the Governments in Canada and practical men from different universities and institutions should meet here to talk and do nothing. If anything serious, if any real business, is to be done by this Commission, we must have the money to do it, and we must make proper representations to Government in regard to the amount of money we shall require.

I do not suppose any of us will be disposed to waste money, to embark on foolish or wildcat enquiries which will not bear fruit. But when we consider

how this field has been neglected in the past in the sense of securing accurate information, and that we have to start at the bottom and build up, we must realize that it will cost a great deal of money. We do not wish to be identified with the operation of any Commission that does not do reliable work. Anything that we put on the public fyles as the report of this Commission must be reliable, and we must, therefore, be in a position to employ proper assistance.

Hon. Mr. Fisher: The staff of the Commission here in Ottawa is under Civil Service rules and the salaries of that staff are provided under the Civil Service rules. The staff provided for is: the Secretary in "A" of the first division, two clerks, technically qualified, in "B" of the first division, two clerks in "A" of the second division, and, I think, two in "B" of the third division: a total of six officials with the Secretary. We thought that, for a time, that staff would be sufficient for the office work here in Ottawa. Probably, in the future, that staff will have to be increased. A sum of $10,000 has been voted for office and miscellaneous expenses in the current fiscal year and the estimates for next year appropriate $15,000 for the same purposes. When that amount was decided on, it was arranged that we would put it in as a preliminary until we knew something of what was required, and we thought that, at any rate, during the current fiscal year, the amount provided would abundantly cover expenses. For the ensuing fiscal year, ending March 31st, 1911, there is now that item in the estimates, with the possibility of increasing it in accordance with the representations of the Commission.

Dr. Beland: How much is required for the officials?

Mr. Fisher: Roughly speaking, about $12,500—in addition to the $10,000.

Mr. Hendry: If we are going to carry the Commission into the effective operation you propose, we will require a much greater amount than has been spoken of. In your address, you stated what you thought this Commission ought to perform for this Dominion; for it is a national Commission, it is not in any sense local. I think you will require to have at your disposal quite a large amount to be divided among the several Committees. I was considering it last night, and I believe that something like $200,000 will be required to bring this Commission into effective operation to produce the results you desire to secure. We should ask for $200,000 to be put at your disposal for use in this matter. If it is not all required, of course it will still be there. With a less amount than that, we will not be able to carry out the researches that are required in order to make this Commission of the value you wish it to be. I had thought of $250,000, but I have moderated a little to $200,000.

Senator Edwards: You mean an annual expenditure?

Mr. Hendry: Yes, for the next fiscal year.

Dr. Bryce: How do you get at that?

Mr. Hendry: By the work that is required to find out our resources. I am on the Mines and the Forests Committees and, if we are to do any good in the mineral line, we must have quite a lot of research to ascertain the best means of utilizing our resources. I understand this is a conservation which does not aim at conserving for future generations all the resources we have, but at providing for the use of some right away. I know that quite a little research has been

made regarding the utilization of our zinc in British Columbia, but we have not arrived at a point where we can utilize it in the shape in which we have had to send it out of the Dominion to be treated. Our great forest resources will require considerable investigation if we are to bring them into the shape I understand you wish to have them in. I think that an amount less than what I have named would be inadequate for you, as Chairman, to distribute to the several Committees.

I have had a good deal to do with general business and general researches for business purposes, and I know pretty well what they cost. This is a large concern, representing, not many millions of dollars, but many billions of dollars. Of course, our recommendations are only the recommendations of the Chairman and of the Commission to the Government and to the country at their back, and I would recommend that we ask for $200,000 to be placed at the disposal of the Chairman of the Commission to use properly where needed.

The Act constituting the Commission should be amended so as to provide for the appointment of Assistant Chairmen who might assist the Chairman in various ways and take charge of meetings in the groups of provinces they would represent.

Reverting to the financial matter, what is $200,000 to this great Dominion when we know of concerns spending millions to find out what they are going to do the next year? What is this but a big concern representing billions? Next year we might want a larger amount or possibly a smaller amount.

Dr. Bryce: I come from Winnipeg, a place where they have large schemes, but I must say that this suggestion is rather startling. The difficulty will be to know what to do with the $200,000. You must have the approval of the country. I know that the investigation suggested will take a large sum. I think we should appropriate an amount to begin some investigations in a thorough manner by choosing the right men, men who would be capable of making the investigations. I think that this might be done by adding $10,000 to the existing vote. That would strike me as a rational thing to do. In the matter of forestry and minerals there must be expert information, and in other matters we will have to make expenditures, but I certainly think, with the $20,000 now provided, another $10,000 will be as much as we ought to think of at the present time.

Senator Edwards: Personally, I am heart and soul in this work. I know that you are, Mr. Chairman, and, as one of the Commissioners, I desire to join you in carrying it out in the most effective way. I believe it is important to Canada; I think nothing is more highly important to Canada, but I do not want to shock the susceptibilities of the Canadian people on the start, and I am sure that if we ask for such an amount as this, it would not be looked on favourably. I do not think the Commission should be hampered at all; I think we should have a sufficiency; but I think we can arrive, in a year from now, more correctly at what we require. It is my opinion that, the officials being provided for, if about $35,000 were added to the $15,000, making it $50,000, it would be a reasonable sum for the first year and would be favourably regarded by Parliament. When the committees get all the information next year, we will be able to form some estimate of what the expenditure necessary for the investigations will be. I am willing to make a motion to this effect.

MR. SNOWBALL: I second the motion.

MR. HENDRY: I agree to that.

HON. MR. FISHER: It would facilitate the passing of an item of this kind through Parliament if some slight budget of the amount were prepared. My colleagues have done me the honour to entrust the work of this Commission, as far as the Government is concerned, to my hands. If a vote of that kind is proposed in Parliament, I suppose I will have to propose and defend it. While I do not think Parliament will be adverse, the size of the vote will be scrutinized. There are those who, perhaps, do not realize as we do, the importance of this work, and the Finance Minister, of course, has to guard jealously, the treasury. I would not like to ask for a vote unless there was some reasonable explanation of what was going to be done with it, and I must say I think it will take some little time to organize our work properly, so that it will be effective, and to secure men to do that work. We want to be careful, at the inception of our work, to search a little, to see that we get the best men, and, therefore, I think it will be unwise to ask Parliament for a sum which we could not reasonably explain the use of.

DR. FERNOW: It would be incumbent on each Committee to prepare a definite schedule of work with prices, just as in any other business. My view is that the Secretary should at once begin collecting information, getting out schedules, etc.

HON. MR. FISHER: I would be glad to make such a motion. I think one of the most important things we have to do is to commence at once on an accurate inventory. It will take a long time and the first steps can be taken at once. I think the staff will be able to do a great deal of that work, occasionally employing experts and sending out occasionally to different parts of the country.

HON. MR. GRIMMER: I would second that motion.

MR. MACKAY: Will you incorporate in it something on public health? There is a strong feeling that this will be one of the most beneficial works of the Commission.

THE CHAIRMAN: This will include public health. We should pass a resolution authorizing the officers to provide for the publication of the official record of the meetings.

A motion to this effect was adopted.

THE CHAIRMAN: Then there is the question of the number of copies.

HON. MR. FISHER: I would be disposed to suggest that the Chairman's address be published in very large numbers for widespread circulation, and that the actual proceedings of the meeting should be published in a smaller number. Perhaps 10,000 of the proceedings and 40,000 or 50,000 of the Chairman's address would be sufficient.

After some further discussion, it was ordered that 10,000 copies of the proceedings be printed in English and 2,500 in French.

THE CHAIRMAN: I have been highly satisfied with the spirit in which this meeting has been carried on. So far as I can recollect, it is the first time a very

comprehensive attempt has been made to do important public service of this character on purely non-partizan lines, an attempt in which men of both political parties have joined together to co-operate in the best interests of the country. For myself, I am very much gratified at the result and at the spirit in which we have been able to meet and work.

It is, indeed, a great work. We have here the first Commission of the kind ever established by a National Government, and it rests with us to show whether such a movement can successfully be brought to a conclusion. I am satisfied that if we continue along the lines on which we have begun, we will accomplish a great deal and will make a magnificent success of the Commission.

I have to thank you for your co-operation, which I have myself personally valued in the highest degree, and I trust we shall get into a satisfactory state of organization and advance the work very considerably by the next meeting of the Commission.

The Commission then adjourned.

INDEX

	Page
ACCIDENTS—	
in mines	14-15
industrial (See Industry)	
Afforestation—	
in France	33
on the prairies	129
Agriculture—	
definition of	40
difficulty of directing by legislation	48
immediate object of	39
place of, in the national economy	24
Robertson, Dr. J. W., on conservation in	37
Allard, Hon. Jules—unable to be present	37
BACTERIA—	
in the soil	56
vitality of, in streams	45
Beaver in the Yukon	85
Beck, Hon. Adam, on the Hydro-Electric Power Project of Ontario	65
Beetle—	
Eastern spruce, attacks of, in New Brunswick	111
bark-boring, methods of attack of	110
Boothby, Col., on sportsmen in Maine	78
Brantford, water supply of	118
British Columbia—	
forest fires, methods of coping with	133
forest resources of	129
topography of central	114
Bryce—	
Hon. James, quoted on influence of nature on man	86
Dr. P. H., on public health	86
Bud-worm, Spruce—operations of, in Canada	108
CALGARY, water supply of	116
Cataract Power Co., water-power head of	120
Chatham, water supply of	118
Climate, as related to agriculture	44
Clover, nitrogen fixation by	43
Columbia river, as a source of water supply	114
Conservation—	
in Canada as compared with the United States	11
contrasted with reckless exploitation	11
history of the movement	10
exceptional character of	9
committees of	127
committees of, reports of	127
committees of, reports of	128
officials of, classified	145
provincial representation on	10
representative membership of	10
Coal—	
imports of, into Ontario from United States	19
loss of life in mining	58
longwall method of mining	58
room-and-pillar method of mining	58
Cobalt, waste in refining cobalt-silver ores	55
Congdon, F. T., on fur-bearing animals in Canada	81
Coutlee, Chas. R., on the water wealth of Canada	112
Crops—	
damage to, by insects	46
field, area and value of in 1909	47
the object of agriculture	39
rotation of, advantages of	42-43
DENMARK, conserving soil fertility in	47
Diphtheria, deaths due to, in Canada	91
Drainage, in Ontario	118
EDMONTON, water supply of	116
Education, agricultural, for mature men	46
Edwards, Senator W. C., on concrete building construction	126

Page.
Electrical Development Co., effect of Hydro-Electric Project on... 66
Electro-thermic process (See Smelting, Iron and Steel) 50
Entomology, relation of, to forest conservation 111
Evans, Kelly, on fish and game in Ontario 77-81
Explosives, Dr. Eugene Haanel's recommendations re 138

FERNOW, DR. B. E.
authorized to collect information abroad 144
on scientific forestry in Europe 27
on forest policies applicable to Canada 36
on forest fires, methods of fighting 133
on forest fires, resolution re methods of fighting 135
summary of main points in address of 36
on timber resources, inventory of 129
Fertilizers—
availability of, to be reported on 139
use of, in England and Scotland 48
Fish—(See under Fish and Game).
public health, relation of supply of, to 80
tax on non-resident anglers in Ontario 73
white fish, depletion of supply of, in Ontario 77
Fish and Game—
economic value of 79
Kelly Evans on 77
preservation of, in Maine 78
preservation of, methods for 83
Fisheries—
committee on 136
committee on, report of 136
Sifton, Hon. Clifford, on 15
Fish Trust, American, operations of, in Ontario 80
Fires, Forest—
aided by forest insects 141
controlling, in British Columbia, A. S. Goodeve on methods of . 133
fighting, Dr. B. E. Fernow's resolution re 137
fighting, Dr. B. E. Fernow's on methods of 133
on I. C. R., Hon. W. C. H. Grimmer on 131-132
on I. C. R., W. B. Snowball on 130
on N. T. R., Hon. W. C. H. Grimmer on 129-130
precautions against, in Ontario forest reserves 60-61
Fires, Forest—
precautions against railway fires in Ontario 61
responsibility of railways for, Hon. C. Sifton on 134
along railways, W. B. Snowball's resolution re 135
Sifton, Hon. Clifford, on 21, 22, 23
sportsmen, taxed, to trace origin of 79
Forests—
area of, in the world 32
British Columbia, forest resources of 129
committee on 126
committee on, report of 126
diseases of forest trees 100
exploitation of, correct attitude towards 31
inspection of, in Germany 105
inventory of, recommended 129
methods of management of 32
municipal ownership of 32
popular attitude re, necessity of change of 35
New Brunswick, forest resources of 131
public opinion on conservation of 20
reserves in Ontario 59
reserve proposed on Eastern slope of Rockies 22
state ownership and management of 32
surveys of, necessity for 35
surveys of, in Nova Scotia 35
Sweden, Forest Conservation Boards in 36
Forestry—
Dominion Forestry Branch 20
history of, rapid outline of 29
origination of, reasons for 31
policies applicable in Canada 36
policies, outline of development of, in Sweden 32
results of, in Prussia 30
results of, in Saxony 30
results of, in Württemberg 30

Forestry—continued. page
schools of, in Canada 20
schools of, in Germany 32
scientific, in Europe 27
France—
municipal ownership of forests in 33
state supervision of forests in 33
French river, power potentialities of 120
Fungus—
bracket 104
damping-off 101
Funds, discussion on, for use of Commission 145
Furs— ....
dyeing and dressing of, in Canada 83
production of, cycles in 83
Fur-bearing Animals
committee on 135
committee on, report of 137
reserves for, advocated 84
Fur-Trade—(See Furs, and Fur-bearing Animals.)
losses in, causes of 82
marten skins, increasing value of 83
statistics re 82

GAME—
committee on 135
committee on, report of 137
fur-bearing animals in Canada 81
fur-bearing animals, destruction of 82
Gas, Natural—
waste of, in Ontario, fine for 64
production of, in Ontario 64
tax on, in Ontario 64
Germany—
forests, municipal ownership of, in..... 32
forestry schools in 32
wheat yield, in 1909 47
Gibson, Arthur, investigation of attacks of spruce bud-worm, by.... 108
Gold, in the Yukon 14
Goodeve, A. S., on forest fires in British Columbia 133
Government management, efficiency of 70
Grand Falls Power Co., power development of 121
Great Britain, wheat yield in 47, 48
Grey, Earl, address by 26-27
Grimmer, Hon. W. C. H.—
on forest fires along I. C. R. 131, 132
on forest fires along N. T. R. 130

HAANEL, Dr. EUGENE.
on economies in mineral production 49
recommendations of, to Committee on Minerals 137
Haileybury, water supply of 110
Hamilton, contracts for power with Hydro-Electric Power Commission 72
Health, Public—
committee on 143
committee on, report of 142
pollution of waters..... 16, 113
preventive measures in 97
Sifton, Hon. Clifford, on 16
tuberculosis, discussed in House of Commons 16
Hewitt, Dr. C. Gordon, on forest insects 105
Hopkins—
quoted on damage to forests by insects 110
quoted on damage by bark-boring beetles 111
Housing problem 100
Howard, L. O., experiments in control of destructive insects 110
Hungary, wheat yields in 47
Hydro-Electric Power Commission—
Beck, Hon. Adam, on 65
municipalities, contracts with 73
municipalities, cost of power supplied to 73
municipalities, amount of power supplied to 73
Ontario Power Co., contract with 72
powers of 67, 72
prices, reduction of, in Hamilton 72

Hydro-Electric Power—Continued. Page.
prices, reduction of, in Ottawa 71
savings effected by 74
Hydro-Electric Project—
Beck, Hon. Adam, on 64
cost of 74
Hydro-Electric Power Commission appointed 65
legislation of 1908 and 1909, re 68
municipalities, commission appointed by 68
Ontario Government acting as agent in 69
Ontario Government commission 66

INDUSTRY, deaths due to 96
Infant depots 89
Insects—
attacks of, on ornamental trees 108
beetles, bark-boring 110
beetles, Eastern spruce, in New Brunswick 111
damage done to Canadian crops by 40
forest, classification of 107
Hewitt, Dr. G. Gordon, on destructive forest 105
larch sawfly 107
loss occasioned by forest 110
moth, brown-tail 109
spruce bud-worm 108
Intercolonial Railway, forest fires along 130, 131, 132
Iron—(See Smelting).
importation of, into Canada 50
ore, magnometric method of locating 52
ore, commercial, minimum standard of 50
ore, limited supply of 40
Irrigation—
in Southern Alberta 116
in the North West 18
on the Pacific coast 114
on prairie rivers 117

KAFFIRS, deaths of, by accidents in South African mines 59
Kaministikwia river, water-power on 120
Klinck, Prof., evolves new variety of Indian corn 45
Kootenay river, as a source of power 115

LACHINE RAPIDS, power from 120
Lands—
Canada, landed estate of 38, 39
committee on 139
committe on, report of 139-140
necessity of, for the people 38
Ontario, area of Crown lands in 60
Ontario, kinds of, for settlement 60
Robertson, Dr. J. W., on conservation of agricultural resources 37
Larch Canker 103
Life—(See Mortality.)
Loss of, in coal and metalliferous mines 58
Lindsey, James A., quoted on struggle for existence 114
London, water supply of 118
Long Sault dam 120
Lumbering, evils of present methods of 20

MACKENZIE basin, water supply of 115
Magnometric measurements 52
Maine, preservation of fish and game in 1 78, 79
Manufacturers' Associations, Canadian, interested in Niagara power. 68
Manufacturing, importance of cheap power for 76
Marten—
value of skins of 84
increasing value of skins of 83
Medicine Hat, water supply of 116
Milk supply—
municipalized 97, 98
regulations re, in Wellington, N.Z. 98
Minerals—
committee on 137
committee on, report of 137
extent of mineral resources 14

Minerals—Continued. Page.
Haanel, Dr. E., on economies in production of 49
Sifton, Hon. Clifford, on 13, 14
value of annual production of, in Canada 14
waste of 15
Mines, Department of 14
Mortality, statistics re 88
Mortality, infant—
Bryce, Dr. P. H., on 88
prevention of 92
Moth, Brown-Tail—
life history of 110
operations of, in Canada 109
Municipalities—
contract of, with Hydro-Electric Power Commission 73
taking power in Ontario from Hydro-Electric Power Commission. 73
cost of power to, when obtained from Hydro-Electric Power Commission 73

NAISH, Dr. A. E., quoted on milk depots..... 89
Natural Resources, Hon. F. Cochrane, on conservation of, in Ontario. 59
Nelson river, water-power potentialities of 118
Nesbitt, Wallace, quoted on attraction of capital by fish and game.. 80
Navigation, inland—
in British Columbia 114
Great lakes system of 119
in lake Winnipeg basin 115
New Brunswick—
forest resources of 131
water-power in 121
New Liskeard, water supply of 119
Newman, Dr. George—
quoted on infant diseases 88
quoted on infant death rate in England 89
New Westminster, water supply of 113
Niagara river, power developments on 120
Nickel, wasteful methods of treating ore 54
Nipigon river, water-powers on 119
Nitrogen—
as a plant food 41
supply of, in the soil 41
supply of, Sir Wm. Crookes quoted on 41
Nova Scotia, water-powers of 121
North American conference, declaration of principles 12, 13

OKANAGAN VALLEY, water supply of 115
conservation of natural resources in 59
water-powers, regulations re granting of rights to 52, 63
Ontario Power Co., contract with Hydro-Electric Power Commission. 72
Organization, discussion on 124
Organizations, co-operating—
committee on 127
committee on, report of 140
Ottawa—
Hydro-Electric Power Commission secures power for 71
water supply of 119
water supply of .....
Ottawa basin, description of upper part of 121
Ottawa river, average volume of flow in 122

PACIFIC COAST—
rain fall on 112
water supply of 112
Patten, H. C., quoted on public health 88
Peat—
commercial importance of 55, 56
experimental fuel-testing station at Ottawa 57
extent of Canadian bogs 56
peat mull, uses of 57
Petroleum, in Ontario 63
Phosphorus, supply of, in the soil 41
Plant growth, elements of, in the soil 41
Plant life, essentials of 41
Pointe du Bois, power station at 119
Poison, use of, in killing fur-bearing animals 82

Pollution of Streams—(See Public Health.) Page.
C. R. Coutlee on 113
Polyporous volvatus 105
Population—
relations of trade returns to 87
value of, as a national asset 87
Port Arthur, secures power through Hydro-Electric Power Commission. 71
Potassium, supply of, in the soil 41
Prairie lakes, characteristics of 116
Press—
committee on 140
committee on, report of 140
Prussia, forestry appropriations in 33
Public Health. (See Health.)
Publicity—
proceedings ordered printed 147
recommendations for securing 145
Pulpwood—
export duty on, in Sweden 32
export of, prohibited from Ontario Crown lands 62
supplies of, along N. T. R. 61

QUEBEC, power supply of city of 121

RABBIT, relation of, to supply of fur-bearing animals 84
Railways, fires caused by 22, 23
Ross, Hon. G. W., regulations by government of, re Niagara power. 67
Ross, R. A., consulting engineer of Hydro-Electric Power Commission 75
Reforestation—
on eastern slope of Rockies 22
importance of 22
in Northern Ontario 22
Prussia's annual expenditure for 33
Regina, water supply of 116
Resources, natural, inventory of 13
Ripley, W. Z., quoted on environment 86
Robertson, Dr. James W.—
authorized to collect information abroad 144
on conservation of agricultural resources 38
contribution of, to scientific argiculture 25
Russia, wheat yield in, 1909 47
Rust, white pine 102

SANITATION—(See Health.)
in schools 91
Saunders, Dr. William—
contribution of, to scientific agriculture 25
contribution of, to seed growing 45
Sawfly, larch—
life history of 107
operations of, in Canada 107
Schools—
health of children in 91
medical inspection of, in England 91
medical inspection of, in New York 91
Seeds—
Seedlings, importation of white pine, into Canada 102
good seed, increased yield from 45
seed grain used in Canada, 1909 44
Shawinigan falls, power at 121
Sifton, Hon. Clifford—
inaugural address 8
on agriculture 24
on funds for Commission 144
on influx of capital into Canada 25
on organization of Commission 142
party politics, disassociation from 11
responsibility of railways for setting forest fires 134
Silver—
smelting and refining ores from Cobalt 14
waste in refining cobalt-silver ores 51
Smelting—
cobalt-silver ores 14, 50, 51
iron ores, difficulty of smelting with blast furnace in Canada.. 50

Smelting—Continued. Page.
iron ores, electro-thremic process of 50
iron ores, electro-thermic process in Sweden 51
iron ores, results of experiments with electro-thermic process... 50
zinc 53-54
Snowball, W. B., resolution re forest fires along railways 135
Soil—
accumulation of, rate of 40
fertility, economic advantages from conserving 45
fertility, depletion of, in Canada 44, 47
organisms in 40
Spanish river, power on 120
Steel, electro-thermic process of making 50
St. Lawrence basin 118
Storage works, on the Upper Ottawa 122
Swamps, effect of, on regulation of stream flow 119
Sweden—
forest policy, development of, in 32
forest resources of 32
Switzerland, water-power law in 19

TAFT, PRESIDENT, on conservation in his message to Congress... 38
Taxation—
non-resident anglers' tax in Ontario 79
uneconomic, of forest lands in United States 12
Ties, scarcity of railway 23
Timber—
export duty on, in Sweden 34
export of unmanufactured Crown Land timber prohibited in Ontario 62
lands, government policy on lease of 20
licenses, Dr. B. E. Fernow on 35
pine, reserves of, in Ontario 59
supply of, world's 32
Trade, Board of, in Toronto, investigates Niagara power 66
Transcontinental Railway, National—
forest fires along 131
forest fires along, precautions against 61
forest fires along, prevention of 23
Transmission, electrical—
high voltage, in Ontario 70
system of, Hydro-Electric Power Commission 73
Trees, diseases of, classified 100
Tuberculosis—
as an after effect of other diseases 94
conditions conducive to 95
deaths from, in Canada in 1900 95
loss, economic, due to 96
Perley, G. H., on, in House of Commons 16
prevention of 95
treatment of, "fresh air," in Germany 96
Typhoid—
decrease of, in England and Wales 92
decrease of, in German cities 92
on the farm 46
in military camps 92
prevention of 95
preventive measure, effectiveness of 96
prevalence of 92
at Sault Ste. Marie 93
in United States cities 95, 96

UNITED STATES—
furs, imports of, from 82
wheat yield, 1909 45

VANCOUVER, water supply of..... 113
Vested interests, effect of Hydro-Electric Project on 74

WATER—
C. R. Coutlee on water wealth of Canada 113
as an essential of plant growth 41
increase of available quantity of 17
sources of supply of 16
streams in Ontario forest reserves 62
uses of 13, 113

Water-power—
in central British Columbia 116
committee on 127
committee on, report of 138
development and use of, laws and regulations for 17
estimated horse-power of, in Canada 19
equivalent of, in tons of coal 19
on French river 120
Grand Falls Power Co., development of 121
on Kaministikwia river 120
on Kootenay river 115
from Lachine rapids 120
on Nelson river 118
in New Brunswick 121
on Niagara river 120
on Nipigon river 120
in Ontario, conditions re disposal of 62, 63
in Ontario, conservation of 64
in Ontario, Hydro-Electric Power Commission, policy re 17
in Ontario, leased under Act of 1898 63
on the upper Ottawa. 122
on the Pacific coast 115
at Shawinigan falls 121
on Spanish river 120
on St. Lawrence river system 120
Swiss legislation re 19
titles to, conditional, recommended 138
uses of 16
in lake Winnipeg basin 117
on Winnipeg river 117
Water supply—
of farm houses 45
pollution of 99
pollution of, Senate's action re 99

White, James, appointment of, as secretary 1
White fish, depletion of supply of, in Ontario 78
Whitson, J. F., quoted on forest fires 19, 21, 22
Wind-power, for light and heat 46
Winnipeg, basin of lake 115
Winnipeg river, water-power on 118
Wolves, destruction of fur-bearing animals by 74

YUKON—
export of furs from 82
fur-bearing animals in, extermination of 84

ZAVITZ, Prof. C. A., contribution of, to seed growing 45
Zinc—
experiments in refining ore 53
Sifton, Hon. Clifford, on 14
smelting of, European processes for 54

REPORT

OF THE

INTERNATIONAL WATERWAYS COMMISSION

ON

THE REGULATION OF LAKE ERIE

WITH A

DISCUSSION OF THE REGULATION OF THE GREAT LAKES SYSTEM

TOGETHER WITH

APPENDIX, TABLES AND PLATES

PRINTED BY ORDER OF PARLIAMENT

OTTAWA
PRINTED BY C. H. PARMELEE, PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1912

[No. 54—1911]

CONTENTS.

REPORT.

Page.

Act authorizing the appointment of the Commission and defining its duties in reference to regulation of Lake Erie 7
Amount of traffic and means of transportation on the Great Lakes 7
Improvements to navigation by deepening natural channels by excavation or by raising lake surface by obstructing flow through outlet 7
Meaning of term "regulation" and methods of regulation 8
Works proposed by Board of Engineers on Deep Waterways 8
The Great Lakes as natural reservoirs 9
Water-level records on the Great Lakes and connecting rivers 10
Volume of discharge through the outlets of the several Great Lakes 11
Supply factors of the Great Lakes 13
Discussion of regulation of Lake Erie between limits 573.7 and 574.7, 1903 levels, proposed by Board of Engineers on Deep Waterways 15
Discussion of regulation of Lake Erie between limits 572.0 and 574.5, 1903 levels 16
- Effect upon Lake Erie 17
- Effect upon Lake St. Clair 17
- Effect upon Lake Michigan-Huron 17
- Effect upon Lake Ontario and St. Lawrence Canals 18
- Effect upon Niagara River 18
- Effect upon city and harbor of Buffalo 18
- Ice jams, head of Niagara River 19
- Effect upon low-lying shores of Lake Erie 19

Summary 20
- Advantages and disadvantages of regulation 20
- Recommendation against regulation of Lake Erie 20

Compensating works in Niagara River 21
- Surveys in progress 21

Discussion of regulation of Lakes Superior, Michigan-Huron, and Ontario 21
Discussion of use of Lake Superior as a storage reservoir to compensate for diversions of water through Chicago Drainage Canal 22

APPENDIX.

The Great Lakes 23
Areas of the several lakes and watersheds of the Great Lakes system 24
Water-level records of the Great Lakes and their connecting rivers 24
- Marquette, Mich 24
- Sault Ste. Marie, Mich 25
- Milwaukee, Wis 25
- Harbor Beach, Mich 25
- G.T.R. (Grand Trunk Railway) near Port Huron, Mich 25
- St. Clair Flats Canal 26
- Windmill Point, Mich 28
- Amherstburg, Ont 28
- Cleveland, Ohio 28
- Buffalo, N.Y 29
- Charlotte, N.Y 29
- Oswego, N.Y 29
- Ogdensburg, N.Y 29
- Lock 27, head of Galop Rapids 29
- Lock 24, head of Rapide Plat 30
- Lock 21, head of Cornwall Canal 30

Nomenclature 30
General equation for stream flow 31
Discharge of St. Marys River, outlet to Lake Superior 32
- Discharge measurements 34
- St. Marys River discharge formulæ, as used for the different efflux conditions 35
- Probable effect upon mean level of Lake Superior of obstructions in St. Marys River at head of rapids 41

St. Clair River discharge 46
Detroit River discharge 47
Niagara River discharge 48
St. Lawrence River discharge 49
Discharge increments of the river outlets of the Great Lakes system 52
Supply factors of Great Lakes 53
- Lake Superior supply factors 55
- Lake Michigan-Huron supply factors 56
- Lake Erie supply factors 58
- Lake Ontario supply factors 60

Page.
Mean monthly supply factors of Great Lakes 61
The regulation of Lake Erie as proposed by the United States Board of Engineers on Deep Waterways 66
Practical regulation of Lake Erie between stages 573.7 and 574.7, 1903 levels 67
Effect of regulation of Lake Erie, between stages 573.7 and 574.7, on water levels of Lake Ontario and St. Lawrence Canals 69
Practical regulation of Lake Erie between stages 572.0 and 574.5, 1903 levels 69
Effect of regulation of Lake Erie, between stages 572.0 and 574.5, on water levels of Lake Ontario and St. Lawrence Canals 70
Effect of regulation of Lake Erie, between stages 572.0 and 574.5, on water levels of Niagara River 71
Effect of regulation of Lake Erie, between stages 572.0 and 574.5, on water levels of Lake St. Clair, Lake Michigan-Huron, and connecting waters 72
Regulation of Lake Superior 73
Diversion of water through the Chicago Drainage Canal, the effect of diversion on Lakes Michigan-Huron, Erie, and Ontario, and the regulation of Lake Superior to compensate for diversion at Chicago 76
Regulation of Lake Michigan-Huron 81
Regulation of Lake Ontario 83
Compensating works in the Niagara River 84

TABLES.

Table A. Areas of the several lakes and watersheds of the Great Lakes system 9
B. Average and extreme variations in levels of the several lakes, 1860–1907 9
C. Average and extreme variation in discharge from the several lakes, 1860–1907 10
Table 1. Areas of the several lakes and watersheds of the Great Lakes system 24
2. Water levels of Lake Superior, at Superior, Wis., and Marquette, Mich 85
3. Water levels of St. Marys River, at Sault Ste. Marie, Mich 86
4. Water levels of Lake Michigan, at Milwaukee, Wis 87
5. Water levels of Lake Huron, at Harbor Beach, Mich 88
6. Water levels of St. Clair River, at Grand Trunk Railway, (G.T.R.) 89
7. Water levels of Lake St. Clair, at St. Clair Flats Canal 90
8. Water levels of Lake St. Clair, at Windmill Point 91
9. Water levels of Detroit River, at Amherstburg, Ont 92
10. Water levels of Lake Erie, at Cleveland, Ohio 93
11. Water levels of Lake Erie, at Buffalo, N.Y 94
12. Water levels of Lake Ontario, at Charlotte, N.Y 95
13. Water levels of Lake Ontario, at Oswego, N.Y 96
14. Water levels of St. Lawrence River, at Ogdensburg, N.Y 97
15. Water levels of St. Lawrence River, at Lock 27 98
16. Water levels of St. Lawrence River, at Lock 24 99
17. Water levels of St. Lawrence River, at Lock 21 100
18. St. Marys River discharge equations for the different efflux conditions 41
19. Discharge from Lake Superior, through St. Marys River 101
20. Discharge from Lake Michigan-Huron, through Detroit River 102
21. Discharge from Lake Erie, through Niagara River 103
22. Discharge from Lake Ontario, through St. Lawrence River 104
23. Increments of discharge of the several rivers of the Great Lakes system 53
24. Supply factors of Lake Superior 105
25. Supply factors of Lake Michigan-Huron 117
26. Supply factors of Lake Erie 131
27. Supply factors of Lake Ontario 141
28. Mean monthly supply factors of the Great Lakes, 1860–1907 151
29. Date of maximum and minimum values of mean monthly supply factors of the Great Lakes 62
30. Ratios: RMAX., TMAX., RMIN 64
31. Mean monthly supply factors of Great Lakes, expressed in cubic feet per second, per square mile of watershed 152
32. Stage of Lake Erie desired on first of month with lake regulated between 573.7 and 574.7 67
33. Regulation of Lake Erie between stages 573.7 and 574.7 153
34. Stage of Lake Erie desired on first of month with lake regulated between 572.0 and 574.5 70
35. Regulation of Lake Erie between stages 572.0 and 574,5 160
36. Effect of regulation of Lake Erie, between stages 572.0 and 574.5, on water levels of Lake Ontario 161
37. Loss of level on Lakes Michigan-Huron, Erie, and Ontario, under the actual and assumed diversions through Chicago Drainage Canal 76
38. Regulation of Lake Superior to compensate for diversion of 4,000 c.f.s. through the Chicago Drainage Canal 162
39. Regulation of Lake Superior to compensate for diversion of 14,000 c.f.s. through the Chicago Drainage Canal 163
40. Effect on water levels of Lake Michigan-Huron, of regulation of Lake Superior to compensate for diversion of 4,000 cubic feet per second through Chicago Drainage Canal .. 164
41. Effect on water levels of Lake Erie, of regulation of Lake Superior, to compensate for diversion of 4,000 c.f.s. through Chicago Drainage Canal 166
42. Effect on water levels of Lake Ontario, of regulation of Lake Superior, to compensate for diversion of 4,000 c.f.s. through Chicago Drainage Canal 168

REPORT

ON

REGULATION OF LAKE ERIE.

INTERNATIONAL WATERWAYS COMMISSION.
OFFICE OF AMERICAN SECTION,
BUFFALO, N.Y., JANUARY 8, 1910.

1. The act of the Congress of the United States, approved June 13, 1902, which requested that the Government of Great Britain be invited to join in the formation of this Commission, defined one of the duties of the Commission as follows, viz.:

"The said Commissioners shall report upon the advisability of locating a dam at the outlet of Lake Erie, with a view to determining whether such dam will benefit navigation, and if such structure is deemed advisable, shall make recommendations to their respective Governments looking to an agreement or treaty which shall provide for the construction of the same, and they shall make an estimate of the probable cost thereof."

2. The Great Lakes, lying between the United States and Canada, with their connecting channels and their natural outlet to the sea, the St. Lawrence River, of which a description will be found in the appendix to this report, constitute the most important system of inland navigation in the world. The traffic which passed through the Detroit River, its busiest link, in 1907, amounted to 71,226,895 tons, valued at about $700,000,000. About 70 per cent. of this traffic is carried in large freight carriers which are loaded down to the greatest draft that can be carried into the harbors or through the channels between the lakes. With the depth now available they are usually loaded to a draft of about 19 feet, but careful watch is kept upon the stage of the waterways and advantage is taken of any temporary increase of stage to load the vessels deeper. The number of deep-draft vessels, as well as their size, and the share of lake traffic which they carry is increasing each year, while the lake traffic itself is increasing with great rapidity. Vessels which would carry an additional load of 85 tons for each inch of additional draft have recently been added to the fleet. Every inch added to the available depth of water would therefore, be of material benefit to commerce.

3. The method heretofore employed for deepening the natural channels is that of excavation, but it has been suggested that a more economical and otherwise better method would be to raise the surface of the water by obstructing the flow of the outlets. For Lake Erie in particular a definite plan, with estimates of cost, was proposed by the Board of Engineers on Deep Waterways in their report dated June 30, 1900, published as House Document No. 149, Fifty-sixth Congress, first session. The official character of this report and the ability displayed in its preparation seem to have led to the provisions of law under which this Commission is now acting, and to make of it a proper starting point for this discussion. It was proposed by the Board to "regulate" the level of Lake Erie.

4. By the term "regulation of a lake's level" is meant the maintenance of its level at or near some fixed stage, which implies such control of the discharge as will make the latter nearly equal to the total supply—rainfall and inflow less evaporation—at all times. In some cases, this may be accomplished by a submerged weir in the outlet, of such length that a small increase or decrease of stage will increase or decrease the discharge over the weir by an amount equal to

the change in the total supply. A work of this kind operates automatically, but manifestly it requires more or less range of stage and the topography must be such that a great length of weir can be found; it does not lend itself to the most complete regulation.

5. The works proposed by the Board were for the regulation of Lake Erie within a range so small that it might be considered almost complete regulation. They consisted of a submerged weir in connection with a set of sluice gates "so designed that with the sluice gates all closed the low-water flow of the regulated stage of the lake will be discharged over the fixed submerged weir, and with the sluice gates all open the additional volume of overflow necessary to maintain the lake at nearly the same level will pass through the sluices at times when the lake is receiving its maximum supply." They were to be placed near the angle in the Bird Island Pier, at the head of Niagara River, and were designed to hold the level of the lake at or near 574.5, old levels, or 574.7, 1903 levels, above mean tide at New York. This is higher than any monthly mean stage reached since authentic records have been kept, that is, since 1860. It was a maximum not to be exceeded. It is not definitely stated what the minimum monthly stage would be under regulation, but it may be inferred from certain paragraphs in the Board's report that it was to be about 573.7, 1903 levels. (See paragraph 104 of the appendix.)

6. The Great Lakes constitute a series of enormous natural reservoirs, each of which serves to regulate the flow in the river constituting its outlet, and to maintain the lake below. They are inter-dependent. The study of one, to be complete, must include the study of all. The total area drained by them is about 287,688 square miles, an area considerably larger than the German Empire. Of this total, about one-third is occupied by the lakes themselves, that is, is devoted to reservoir purposes. The result is a unformity of level and a uniformity of flow which is truly wonderful. In Table A are given the areas of the lake surfaces and of the drainage basins.

TABLE A.

LAKE	AREA OF LAKE SURFACE IN SQUARE MILES.	DRAINAGE AREA, INCLUDING LAKE SURFACE IN SQUARE MILES.	RATIO OF LAKE TO DRAINAGE AREA.
Superior	32,060	76,134	1: 2.37
Michigan	22,336	65,799	1: 2.95
Huron	22,978	72,008	1: 3.13
St. Clair	503	6,194	1: 12.31
Erie	9,968	34,573	1: 3.47
Ontario	7,243	32,980	1: 4.55
Total	95,088	287,688	1: 3.02

Authority: 1906 U.S. Lake Survey report.
The areas of the small lakes and streams are taken as a part of the land area.

In Table B are given the average and the extreme variations in the levels during the period from 1860 to 1907.

TABLE B.

	SUPERIOR.	HURON.	ERIE.	ONTARIO.
	feet	Feet	Feet	Feet
Extreme range 1860-1907	3.32	4.64	3.89	5.54
Maximum range in 1 year	(1869) 2.67	(1876) 1.94	(1892) 2.28	(1867) 3.65
Minimum range in 1 year	(1891) 0.49	(1879) 0.59	(1895) 0.87	(1907) 0.79
Average annual range	1.18	1.21	1.56	1.93

In Table C are given the average and the extreme variations in the discharge of the outlets for the period 1860 to 1907:

TABLE C.

	St. Marys River	Detroit River.	Niagara River.	St. Lawrence River at its Head.
Average discharge for entire period	82,000 c.f.s.	204,200 c.f.s.	212,200 c.f.s.	254,400 c.f.s.
Greatest excess average for any one month	46,700 Sept., 1869. 57%	71,200 July, 1883. 35%	45,600 June, 1876. 21%	96,800 May, 1862. 38%
Greatest excess average for any one year	19,100 1876. 23%	30,200 1885. 15%	26,500 1876. 12%	49,000 1862. 19%
Greatest deficiency average for any one month	33,800 Feb., 1893. 41%	98,900 Feb., 1874. 48%	43,500 Mar., 1896. 20%	102,200 Feb., 1902. 40%
Greatest deficiency average for any one year	16,900 1879. 21%	30,600 1896. 15%	31,800 1895. 15%	62,800 1895. 25%

No work of man ever has approached or ever will approach this perfection of regulation. The question now is, can he add to that which exists in any important degree?

7. Evidently the answer to this question must be based upon careful analysis and close computation. The data for its solution are found in the records of the water levels, and in the measurements of discharge taken during the last 48 years, principally under the direction of the Chief of Engineers, U.S. Army. Actual values assigned to rainfall and evaporation are not well determined and cannot be used. It is the relative value of these elements which it is necessary to know, and that value is found in the discharge measurements.

8. Soon after the organization of the Commission, a committee of two of its engineer members was appointed to collect all of the available data, and to make an hydraulic analysis of the general regulation of all the lakes. It was well known at the outset that this would be a long and laborious task, but it proved to be more so than was expected, and it was only recently completed. The full report of the committee is hereto attached as an appendix. A brief synopsis of it is here given.

9. Beginning about 1860, and continuing to date, daily or tri-daily water-level observations have been taken at Marquette on Lake Superior, Milwaukee on Lake Michigan, Cleveland on Lake Erie, and Oswego and Charlotte on Lake Ontario. Beginning at later dates, observations have been taken at Sault Ste. Marie, Harbor Beach on Lake Huron, St. Clair River, St. Clair Flats Canal, Windmill Point on Lake St. Clair, Amherstburg on Detroit River, Buffalo on Lake Erie, Ogdensburg on St. Lawrence River, and Lock 27 at the head of Galop Rapids, Lock 24 at the head of Rapide Plat, and Lock 21 at the head of Long Sault Rapids, on St. Lawrence River. Self-registering automatic gages giving a continuous graphical record of the rise and fall of the water, were not installed until 1899. The record for each of the above-mentioned gages, except the last two, from 1860 to 1907, inclusive, has been completed by interpolation. For Lock 24 on the St. Lawrence, the record has been completed from 1880, and for Lock 21, from 1870. There are a few isolated records of dates earlier than 1860, but they are not well authenticated and cannot be used here.

10. As was stated in our report of January 4, 1907, upon the Chicago Drainage Canal, "Variations in the level of the lake's surface, due to winds and to change of barometric pressure, are frequent and irregular and at times

violent. Variations of more than 6 inches are very common, often occurring hourly for many hours in succession, while variations of 2 or 3 feet within an hour are not uncommon. Besides these irregular variations there is a regular annual variation due to difference in rainfall, evaporation, and run-off, the water level being highest in midsummer and lowest in midwinter. The levels are affected also by the greater or less severity of the winter and by the consequent greater or less decrease in the discharging capacity of the outlets by ice. In order to study the annual oscillations it is necessary to eliminate the irregular oscillations, and that is accomplished by using the average levels for a month." The monthly mean stage has been obtained by taking the average of the gage readings for a month, and is given for each of the above-mentioned gages in Tables 2-17. The monthly mean stages of Lakes Superior, Michigan-Huron, St. Clair, Erie, and Ontario, from 1860 to 1907, inclusive, are shown on Plate 1.

11. The volume of discharge of the outlet at any given stage is obtained from a formula deduced from actual measurements of discharge at such stages as happened to exist at the time of observation. Formulæ of this kind were deduced for each of the outlets of the Great Lakes. During the winter of 1896 discharge measurements of the St. Marys River, the outlet of Lake Superior, were made at Spry's Dock Section, located about a mile below the St. Mary's Rapids. In 1902 discharge measurements of the same stream were made at the International Bridge which connects Sault Ste. Marie, Mich., with Sault Ste. Marie, Ontario. In 1905 similar measurements were made at "Section Brewery," located about 2,000 feet below Spry's Dock Section. All of these observations were made by the U.S. Lake Survey. Up to the year 1887, the discharging capacity of the St. Marys River remained nearly uniform. Since that date, numerous artificial works have been constructed at the Sault, which have modified its discharging capacity to an important degree. During the years 1887 and 1888, the International Bridge was built, which with its piers and approaches materially reduced the cross section. In 1892, the Edison Sault Electric Company placed power works in the bed of the stream. In 1895, a power canal on the Canadian side was opened to use. In 1905, a power canal on the Michigan side was opened to use, compensating works in connection therewith having been placed in the river in 1901 and 1902. The amount of water diverted by the power canals has increased from time to time since they were opened, and so has the quantity used by the American and Canadian locks. To conform to these changes it was necessary to deduce eleven different discharge formulæ for the St. Marys River alone.

12. The discharge formula for St. Clair River, the outlet of Lake Michigan-Huron, was deduced from observations made by the U. S. Lake Survey in 1899, 1900, 1901, and 1902. In 1900, the Chicago Drainage Canal began diverting water from Lake Michigan. The amount diverted between January, 1900, and June, 1904, inclusive, was computed from data furnished by the U. S. Engineer Office at Chicago. The flow through the canal since June, 1904, has been assumed to be 4167 cubic feet per second, the quantity authorized in the permit of the Secretary of War. It is believed to have been greater, but the difference is not sufficient to vitiate the results sought for here. An application by the Commission to the Sanitary District of Chicago for a copy of their record met with a refusal to furnish it.

13. The discharge formula for the Detroit River was derived from measurements taken at Fort Wayne, Michigan, by the U. S. Lake Survey in 1901 and 1902.

14. For the Niagara River, the outlet of Lake Erie, discharge measurements were made at the International Bridge at Buffalo, and at a point about 1,800 feet down stream, called the "Open Section." These observations were begun

in 1897 for the Board of Engineers on Deep Waterways, and were continued in 1898, 1899, and 1900, by the U. S. Lake Survey.

15. The discharge formula for the St. Lawrence River, the outlet of Lake Ontario, was deduced from measurements made by the U. S. Lake Survey in 1901 and 1902 at "Three Points Section," situated about 15 miles below Ogdensburg, N.Y., and 9 miles below the head of the Galop Rapids.

16. With the discharge formulæ and the gage records, the average discharge in cubic feet per second, has been computed for each month from 1860 to 1907, inclusive, for each outlet. The results for St. Marys River are given in Table 19; those for Detroit River in Table 20; those for Niagara River in Table 21; and those for St. Lawrence River at its head in Table 22.

17. The total supply of water to a reservoir or lake depends upon the inflow or transmitted supply from another watershed, the precipitation on the surface of the lake, the run-off from the lake's watershed, and evaporation from the lake's surface, or the outflow from and storage in the lake. Of these factors, for the Great Lakes, the transmitted supply, the discharge, and the storage are known separately, while the value of precipitation, run-off, and evaporation is known collectively. The local supply for any lake is the water-yield from its own watershed, and is equal to the total supply minus the transmitted supply or inflow from the watersheds situated above. The supply factors have been deduced for Lakes Superior, Michigan-Huron, Erie, and Ontario, for each month from 1860 to 1907, inclusive, and the results are given in Tables 24, 25, 26 and 27. They are shown graphically upon Plates 2 to 17 inclusive.

18. It is to be noted that minus values for the monthly mean local supply have frequently occurred, that is to say, the evaporation has frequently exceeded the precipitation and run-off. For Lake Superior, minus values occurred at some time during 41 of the 48 years considered; this usually happened in December, but it sometimes occurred in each of the months from October to April, inclusive. The greatest minus value occurred in December, 1870, when the evaporation exceeded the precipitation and run-off by 106,600 cubic feet per second.

19. For Lake Michigan-Huron, minus values occurred in 33 out of the 48 years considered. This usually happened in September, October, or November, but it sometimes happened also in August and December. The greatest minus value occurred in September, 1871, when the evaporation exceeded the precipitation and run-off by 125,700 cubic feet per second. In that year minus values occurred in each of the four months from August to November. In 1894, minus values occurred from August to December, inclusive.

20. For Lake Erie, minus values occurred with extraordinary frequency. They are found in every year, and, in many years in all of the last six months. From June, 1884, to March, 1885, inclusive, that is, for 10 consecutive months, evaporation exceeded precipitation and run-off continuously, the average excess for the entire period being 40,400 cubic feet per second. There is no month, except the month of May, in which a minus value has not been found in some year between 1850 and 1907. The excessive evaporation in Lake Erie may be attributed to the facts that the lake is shallow and its longer axis lies in the direction of the prevalent winds.

21. For Lake Ontario, minus values occurred less frequently than with the other lakes, but were found in 27 out of the 48 years. The greatest minus value occurred in January, 1877, when the evaporation exceeded the precipitation and run-off by 40,300 cubic feet per second.

22. To obtain the general law which governs these supply factors, Table 28 was prepared, which gives their average for the entire period from 1860 to 1907. The averages for Lakes Superior, Michigan-Huron, Erie, and Ontario are shown graphically on Plate 18. From these, it appears that evaporation exceeds the local supply in Lake Superior during December and is nearly equal to it during January; that evaporation is nearly equal to the local supply in Lake Michigan-Huron during October and November; that it exceeds the local supply in Lake Erie during the last half of the year, July to December; and, as a general rule, does not exceed the local supply in Lake Ontario.

23. The maximum stage of one lake does not occur at the same time as that of another lake, and this is true also of the minimum stage. Nor does the maximum outflow occur at the time of the maximum total supply, nor the minimum outflow at the time of the minimum total supply. The lake may continue to fall while the supply of water is increasing and *vice versa*. These great forces require time to act. The following table shows the ratio, R, between the maximum discharge and the maximum total supply for each lake, the time interval, $T_{MAX.}$, which elapses between the maximum total supply to any lake and the maximum discharge from that lake, and the time interval, $T_{MIN.}$, which elapses between the minimum total supply and the minimum discharge

LAKE	R	$T_{MAX.}$	$T_{MIN.}$
Superior	0.524	98 days	91 days
Michigan-Huron	0.647	82 "	101 "
Erie	0.884	76 "	132 "
Ontario	0.955	56 "	20 "

From which it is to be inferred that the interval of time required for an increasing supply to show its effect upon the level of Lake Superior is about 98 days, and for a decreasing supply it is about 91 days; in Lake Erie, the corresponding intervals are 76 days and 132 days respectively; for the other lakes, the intervals are somewhat less.

24. With the data which have been given, it is now possible to show what the practical result will be of an attempt to regulate the level of any lake within any given limits. For illustration, the Commission has selected the regulation of Lake Erie, between the limits 573.7 and 574.7, 1903 levels, by means of a submerged weir and sluice gates, as proposed by the Board of Engineers on Deep Waterways. In this case, the sluice gates cannot be set daily or at frequent intervals, to meet conditions as they arise, because of the difficulty of ascertaining what the true level of the lake is and what its consequent discharge is at any particular time. The irregularity and occasional violence of its oscillations make it necessary to take the average of a considerable number of observations—usually those of a month—to find the true level. The gates can, therefore, be set not oftener than once a month, and then only approximately. It is necessary to fix upon some definite elevation for the stage of the lake at the beginning of each month and then to set the sluice gates to give a discharge which will bring the lake to the level desired at the end of the month. That is to say, it is necessary to estimate the total supply which the lake will receive during the month to come. For regulation between the levels 573.7 and 574.7, the stage values at the beginning of each month should be approximately as follows:

January 1	573.8	May 1	573.9
February 1	573.7	June 1	574.0
March 1	573.7	July 1 to November 1	574.0
April 1	573.8	December 1	573.9

In Table 33 are given the actual supply to Lake Erie, and the supply which would have been estimated if regulating works had been in operation for each

month from January, 1890, to December, 1906, inclusive, and their difference. The table gives also the level which the lake would have reached with regulating works, and the difference between the stage reached and the stage desired. The actual supply and the stage are rarely identical with those expected, and in some cases the differences are important. For example, the actual supply in March, 1891, was 37,100 cubic feet per second less than would have been estimated, and in the following month, April, 1891, it was 47,800 cubic feet less than would have been estimated; the stage reached at the end of April, 1891, would have been 573.48, or 5 inches lower than the stage desired. In April, 1892, the supply was 40,200 cubic feet per second, and in the following month it was 29,400 cubic feet per second, more than would have been estimated, and the stage reached at the end of May would have been 574.54, or about 6½ inches higher than the stage desired. In July, 1892, the actual supply was 35,300 cubic feet per second less than would have been estimated. In June, 1893, the actual supply was 39.000 cubic feet per second less than would have been estimated, and in June, 1901, was 32,300 more. Numerous other instances of important differences will be found in the table. They may occur in any part of the year. They show that it is not possible to foretell the stage under regulation, a month in advance, within 5 or 6 inches; that is to say, that a margin of about 6 inches must be allowed at the upper and lower limits proposed for regulation. If the attempt be made to regulate within a range of one foot, with this margin, there will be no range left for setting the sluice gates, which is absurd. In other words, the regulation of Lake Erie within a range of 1 foot, or between the limits 573.7 and 574.7, is impracticable.

25. It appears, however, from a study of Table 33, that it would have been possible during the period covered by the table, 1890 to 1906, to regulate the level of the lake between the limits 573.31 and 574.74, or within a range of about 18 inches. This period covers the extreme low-water year, 1895, but not an extreme high-water year, like that of 1876. Computations were made to ascertain the effect of regulation between the limits 572.0 and 574.5 in the two extreme years. The results are given in Table 35, and are shown graphically on Plate 21. It is found that the extreme range from high water of 1876 to low water of 1895 which was 3.78 feet, would under regulation have been reduced to about 2.5 feet. The high levels of 1876 would not have been raised, but the low levels of November and December, 1895, would have been raised 1.38 and 1.37 feet, respectively, and the annual mean level of 1895 would have been raised about 1.07 feet. This would benefit Lake Erie, and is, therefore, worthy of examination.

26. It must not be forgotten that these numbers refer to monthly mean or annual mean stages. It sometimes happens that the stage varies as much as 7 or 8 feet in one day, and more than 2 feet in one hour. Storms raise the water level, at Buffalo, several feet higher than normal, and lower it, at Amherstburg, by a like amount; the difference of level between the two ends of the lake in extreme cases having been as great as 15 feet. To control these irregular variations is impossible. It is possible only to regulate the monthly mean stage within the limits of about 2.5 feet. Whether or not it will be expedient to undertake the regulation of Lake Erie between these limits must depend upon the following considerations.

27. Effect Upon Lake Erie. An examination of Plate 21 shows that for a year of excessive supply, such as 1876, the regulation of Lake Erie would not improve navigation. In 1895, a year of deficient supply, the mean level during the eight-month season of navigation would have been raised from 571.31 under natural conditions to 572.41 under regulated conditions, and navigation would have been improved by an increase of 1.1 feet in the stage. The extreme low stages for the navigation season would have been raised at

least 1 foot without appreciable increase in the extreme high stage. This is equivalent to deepening every harbor and channel in Lake Erie by that amount.

28. Effect Upon Lake St. Clair. The increase in the stage of Lake Erie will decrease the mean slope in the Detroit River, and will cause Lake St. Clair to rise, until the slope be so far restored as to give to the discharge through the Detroit River a value equal to the natural discharge. The amount which Lake St. Clair will rise on account of an increase of 1 foot in the stage of Lake Erie, is computed to be 0.61 foot. (See paragraph 121 of the Appendix.)

29. Effect Upon Lake Michigan-Huron. As backwater from Lake Erie raises the level of Lake St. Clair, so backwater from Lake St. Clair raises the level of Lake Michigan-Huron. The effect of an increase of 0.61 foot in the stage of Lake St. Clair is to raise the level of Lake Michigan-Huron 0.27 foot. (See paragraph 123 of the Appendix.)

30. Effect Upon Lake Ontario, and the St. Lawrence Canals. Any change in the outflow of Lake Erie will change the water levels of Lake Ontario. If the inflow to Ontario is increased, the lake level will rise, and with decreased inflow the level will fall. For the extreme years, 1876 and 1895, the effect upon Lake Ontario of the regulation of Lake Erie is shown in Table 36, and on Plate 21. For the high water year, 1876, there would have been but little change; at no time during the year would the regulated stage of Lake Ontario differ from the actual stage more than 1½ inches. In 1895, the low water year, the oscillation would have been increased. The high water of May would have been about 1 inch higher, while the low water of September, October, and November, would have been 4.08, 4.46, and 4.00 inches, respectively, lower under regulation than under the natural conditions. To lower the level of Lake Ontario is to lower the St. Lawrence River and to injuriously affect navigation in the St. Lawrence canals. A comparison of the gage records upon Lake Ontario and at these canals shows that a fall of 4.56 inches in the level of Lake Ontario will lower the level in the Galop canals about 4.56 inches, in the Morrisburg canals by about 6.65 inches, and in the Iroquois Canal, Lock 25, by about 7.66 inches. During periods of low-water it would be necessary to diminish the draft of vessels navigating the canals about 7.66 inches, by decreasing their loads.

31. Effect Upon Niagara River. The effect upon Niagara River would not be important. The stage would not fluctuate through any greater range than under natural conditions. During the winter months, more frequent low water would probably occur, in which case the power companies at Niagara Falls would probably have more difficulty in keeping the channels to their intakes free from ice. During the autumn months navigation might be slightly injured by the prolongation of the low-water season, due to the storage in Lake Erie of a part of the natural discharge.

32. Effect Upon the City and Harbor of Buffalo. Low-lying portions of the City of Buffalo and the adjacent territory are subject to overflow both from the lake and from tributary streams, especially Buffalo Creek. Floods from the lake are due to storms blowing from the southwest. During the severe storm of January 20, 1907, Lake Erie rose to 579.45, or 6.49 feet above the mean for that month, or 7.0 feet above the mean of the preceding and following months. Iron furnaces were extinguished, a pumping plant was seriously crippled, and much damage was inflicted upon the lands and property in Buffalo adjacent to the lake and to Buffalo Creek. Under regulation, the monthly mean level of the lake upon that occasion would have been about 2½ inches higher than it was and the height of the flood would have been increased by that amount. Floods from Buffalo Creek are now of common occurrence. With

a few days of warm weather in the winter, the discharge of the creek becomes so great as to overflow its banks, and the water sometimes floods an area of 1,600 acres, having a population of 10,000. It is stated by the Department of Public Works of Buffalo that a rise of 2 feet in the stages of the lake causes a rise of about 1 foot in Buffalo Creek in the center of the flood district. Most of the floods in Buffalo Creek occur during January, February, and March, when Lake Erie is at its lowest stage. Some of the greatest floods have occurred during the extreme low-water periods, such as those in the winters of 1896, 1898, 1900, and 1902. With the winter level regulated at a height greater than it actually was upon those occasions, the flood height would have been increased, and greater damage would have occurred.

33. Ice Jams. During every winter ice jams form on Horseshoe Reef at the head of Niagara River. The ice in the lake is blown toward the outlet by a southwest wind, and is piled upon the shallow reef, where it forms an ice jam extending from near the bottom to several feet above the surface of the water. In some instances, the bergs have been 20 to 30 feet high. The proposed regulating works, being placed about a mile below Horseshoe Reef, would aggravate this difficulty. The neck of the outlet might become so effectively blocked with ice that the flow of the river would be materially decreased as was the flow of the St. Clair River in the winters of 1901 and 1902. If those conditions should exist, a severe southwesterly storm, such as has occurred on numerous occasions, would inundate the lower part of Buffalo. These ice jams seriously interfere with navigation. The average date of opening navigation in the spring, at Buffalo, is April 9, while at Cleveland, the average date is March 23. The difference of 17 days in the dates of opening the two Lake Erie ports is due to ice jams. It is probable that it would be materially increased by the construction of the regulating works. It is to be observed that the ice jams would make it difficult to maintain the works.

34. Effect Upon the Low-lying Shores of Lake Erie. There are low-lying portions of the shores of Lake Erie where the water is shut out by dykes and where pumping is now required. To raise the level of the lake would increase the amount of such pumping. It is possible, also, that there are points other than Buffalo, where great commercial interests are concentrated, and where local drainage is deficient, but for reasons which will appear presently it has not been considered necessary to make a detailed investigation of every locality.

35. The advantages then of regulating Lake Erie, between the limits 572.0 and 574.5, are that the low-water stages of Lake Erie will be raised about 1 foot; those of Lake St. Clair will be raised about 0.61 foot; and those of Lake Michigan-Huron, about 0.27 foot; without in any case increasing the high water stage.

36. The disadvantages are that the oscillations in Lake Ontario are increased about 5½ inches, and low water is made lower by about 4½ inches; that the depth in the St. Lawrence canals will be diminished by about 7.66 inches; that the city of Buffalo and its southerly suburbs will suffer by increased damage from floods, and from a postponement of the date of opening navigation in the spring.

37. In weighing these advantages and disadvantages, it is to be remembered that the persons who are to benefit by the former are not identical with those who are to suffer from the latter. Those navigating the St. Lawrence canals are not specially concerned with deepening the harbors of Lake Erie; nor are those occupying the low-lying portions of Buffalo sufficiently compensated for the injury to their property by the beneficial effects upon navigation. If the advantages and disadvantages could be equally distributed, we are inclined to think that the former would outweigh the latter, and that the expediency

of the undertaking would be a question of cost. As the matter stands, it involves the question of damages to vested rights, which in this case is peculiarly intricate. It is our opinion that the advantages are not of such overwhelming character as to justify the two governments in entering upon that vexatious question, and we therefore recommend that the "regulation" of Lake Erie be not undertaken, meaning thereby the most complete practicable regulation such as can be secured by a dam and sluice gates located at or near Buffalo.

38. It does not follow that nothing can advantageously be done to improve or maintain the level of the lake. It is possible to raise the level of any lake by simply reducing the size of the outlet. With a reduced cross section, the outlet requires a steeper slope, and the average level of the lake is raised, but the oscillations will go on as before, and the discharge will remain the same. To raise the level of Lake Erie will raise also, but to a less degree, the levels of Lake St. Clair and of Michigan-Huron, and will thus benefit those waters, while it will have no effect upon Lake Ontario or the St. Lawrence River. It would be physically practicable to raise the level many feet, but here again vested rights must be considered, and the amount which the level should be raised is in our judgment limited to that which will not interfere with those rights.

39. It is believed that somewhere in the Niagara River, between Lake Erie and the Falls, a submerged dam may be placed which will greatly benefit the navigation of the waters above without injury to those below and with only minor damages, if any, to the adjoining lands. Without any attempt to "regulate" Lake Erie, the level of the lake may be raised sufficiently to compensate for the damages heretofore inflicted by the Chicago Drainage Canal and other deteriorating influences. To distinguish works of this kind from those designed to "regulate" the lake, they may be called "compensating" works.

40. The upper Niagara River is a valuable safety-valve for the protection of Buffalo from the effects of storms upon Lake Erie, and should not be obstructed by a dam. It is possible that the extreme lower end of the reach, that is, the section just above the Falls, may not be available because of excessive overflow to be caused in the valley of the Welland River. To determine the best site it has been necessary to make additional surveys. These were begun in July, 1909, and are still in progress. After their completion it is our intention to submit a supplementary report upon the subject.

41. In connection with the hydraulic analysis of the general regulation of all the lakes, attention is invited to a discussion of the regulation of Lake Superior, of Lake Michigan-Huron, and of Lake Ontario, which will be found in the Appendix, paragraphs 125-132, 148-155. Without going into details it may be stated in general terms, that, as in the case of Lake Erie, only a very moderate degree of improvement in regulation over what nature provides is practicable in any of the lakes, and that, such as it is, this improvement is obtained at the expense and to the injury of the navigable channels below. If the level of any lake has been lowered, whether by diversion through the Chicago Drainage Canal or by enlargement of the outlet, the remedy seems to lie in "compensation" rather than in "regulating" works.

42. Attention is invited also to a discussion of the use of Lake Superior as a reservoir, which has been proposed by persons not familiar with the Great Lakes, to compensate for the diversion of water through the Chicago Drainage Canal (see Appendix, paragraphs 133-147). The result of the discussion is to show: 1, that Lake Superior, being naturally one of the greatest and best regulators of flow to be found in the world, maintains a flow in the St. Marys River, its outlet, which is remarkably uniform; 2, that uniformity of flow in that river is essential to the best interests of navigation of the river itself; 3, that during

the winter months when navigation is suspended this uniformity of flow is still necessary to maintain the level of Lake Huron and keep it in condition to maintain in its turn the St. Clair and Detroit Rivers in the spring when navigation opens. It is not in the power of man to improve this uniformity of flow to any important degree. He may disturb it, making it less uniform, by storing water in Lake Superior, but any water withheld at one season would create a deficiency in the lake below, which must be replaced by an equivalent increase of discharge from Lake Superior at another season. This would simply increase the oscillations in the level of the lakes below, that is, would injure them, without compensating in any degree for the diversion of water through the Chicago Drainage Canal.

GEO. C. GIBBONS,
Chairman, Canadian Section.

W. J. STEWART,
Member, Canadian Section.

LOUIS COSTE,
Member, Canadian Section.

O. H. ERNST,
Brig. Gen'l, U.S. Army, Retired,
Chairman, American Section.

GEORGE CLINTON,
Member, American Section.

E. E. HASKELL,
Member, American Section.

Attest:
W. EDWARD WILSON,
Secretary, American Section

THE MINISTER OF PUBLIC WORKS OF CANADA.
THE SECRETARY OF WAR OF THE UNITED STATES.

APPENDIX.

INTERNATIONAL WATERWAYS COMMISSION.
OFFICE OF AMERICAN SECTION,
BUFFALO, N.Y., December 4, 1909.

THE INTERNATIONAL WATERWAYS COMMISSION:

Your Committee, which was appointed to investigate the advisability of locating a dam at the outlet of Lake Erie (as proposed by the Board of Engineers on Deep Waterways) and the maintenance and regulation of suitable levels on the other lakes in the Great Lakes system, now has the honor to report upon these subjects. It is hoped that this investigation will be of assistance to the Commission in considering the subjects mentioned above.

THE GREAT LAKES.

1. The Great Lakes, comprising Lakes Superior, Michigan, Huron, Erie, and Ontario, situated between the United States and Canada, differ from the high seas in that the latter have diurnal tides while the former have periodic and seasonal stage cycles. Lake Superior, the largest of these lakes, has a length from Duluth to Point Iroquois, of 383 miles and a breadth of approximately 160 miles. Its maximum recorded depth is 1012 feet. The outlet of this lake is the St. Marys River. The length of Lake Michigan is approximately 321 miles; its breadth, 118 miles, and its maximum measured depth 870 feet. Lake Huron is about 220 miles long and 101 miles wide, with a maximum measured depth of 750 feet. Lakes Michigan and Huron are connected by the Strait of Mackinac, and their outlet is the St. Clair River. Lake St. Clair is approximately 26 miles long and 24 miles wide; its maximum depth is less than 24 feet, except at the head of the Detroit River, the outlet of the lake. Lake Erie is about 240 miles in length, with a maximum width of 57 miles; its maximum depth as recorded by the U.S. Lake Survey, is 210 feet. Niagara River is the outlet of this lake. Lake Ontario is about 190 miles long, 57 miles wide, and has a maximum recorded depth of 730 feet. The present natural outlet of this lake, as well as of the entire Great Lakes system, is the St. Lawrence River.

AREAS OF THE SEVERAL LAKES AND WATERSHEDS OF THE GREAT LAKES SYSTEM.

2. The areas of the surfaces of the Great Lakes and their watersheds, as determined by the United States Lake Survey, are shown in Table 1.

TABLE I.

LAKE	AREA OF LAKE SURFACE IN SQUARE MILES.	DRAINAGE AREA, INCLUDING LAKE SURFACE, IN SQUARE MILES.	RATIO OF LAKE TO LAND AREA.
Superior	32,060	76,134	1: 1.37
Michigan	22,336	65,799	1: 1.95
Huron	22,978	72,008	1: 2.13
Michigan-Huron	45,314	137,807	1: 2.04
St. Clair	503	6,194	1: 11.31
Erie	9,968	34,573	1: 2.47
Ontario	7,243	32,980	1: 3.55

Authority: 1906 United States Lake Survey report. (Unpublished).

3. The land area for any watershed is considered as the difference between the total drainage area and the area of the lake surface. The areas of the small lakes and streams are taken as a part of the land area.

4. The ratio of lake to land area is least for Superior and greatest for St. Clair, and increases with each succeeding lake lower in the system, St. Clair excepted.

WATER-LEVEL RECORDS OF THE GREAT LAKES AND THEIR CONNECTING RIVERS.

5. Beginning about 1860 and continuing to date, daily or tri-daily water-level observations have been taken on the several lakes and connecting channels of the Great Lakes. These readings have been reduced to monthly mean stage by determining the average for the month. In 1899, the first self-registering automatic gauges, giving a continuous graphical record of the rise and fall of the water, were installed. The water-level records tabulated in this report pertain directly to the stage of the waters of the Great Lakes system. In nearly every instance, they have been placed at the service of the Commission through the Chief of Engineers' reports, or have been obtained from the United States Lake Survey.

6. Marquette. The elevation of the water surface of Lake Superior above mean tide at New York was observed at Superior, Wis., for the period from 1860 to 1871, inclusive, while from 1872 to 1907, inclusive, it was observed at Marquette, Mich. The self-registering gage, located at Marquette, was placed in operation in November, 1902. During the forty-eight years of observations there were months when no records were taken. For the years 1860 and 1861, missing values have been supplied by adding (algebraically) to the observed reading of the following or preceding month the monthly mean rise or fall of water surface from 1860 to 1871, inclusive. Missing values in the period from 1871 to 1888, inclusive, have been supplied by adding to Sault Ste. Marie, Mich., readings the monthly mean fall from Marquette to Sault Ste. Marie for that period. Missing values for the period from 1889 to 1901, inclusive, have been supplied from the Sault Ste. Marie readings by applying to these readings the monthly mean fall from Marquette to Sault Ste. Marie for that period. The stage of Lake Superior, from 1860 to 1907, inclusive, at Marquette, Mich., and Superior, Wis., is given in Table 2.

7. Sault Ste. Marie. The monthly mean stage of the St. Marys River, the outlet to Lake Superior, was observed at the southwest pier, Sault Ste. Marie, Mich. (above the locks), from November, 1870, to December, 1907, inclusive. Before November, 1899, the readings were taken with a staff gage, but since that time a self-registering gage has been in operation. To make the records complete from January, 1860, to October 1870, inclusive, the mean monthly fall from 1871 to 1888, inclusive, from Marquette to Sault Ste. Marie, has been subtracted from the corresponding Marquette readings. These monthly mean stages at Sault Ste. Marie (above the locks) are given in Table 3.

8. Milwaukee. The water-level records giving the stage of water of Lake Michigan, from 1860 to 1907, inclusive, were taken at Milwaukee, Wis. The monthly mean elevations of water-surface are given in Table 4.

9. Harbor Beach. From September, 1874, to December, 1907, inclusive, the stage of Lake Huron was observed at Harbor Beach, Mich. (formerly Sand Beach). From April, 1901, to December, 1907, inclusive, the stage was recorded by a self-registering gage. The water levels from January, 1860, to August, 1874, inclusive, were derived by the United States Lake Survey (see page 4105, appendix EEE, annual report of the Chief of Engineers for 1904), as follows:

January, 1860, to September, 1864, inclusive, from observations at Point aux Barques; and October, 1864, to August, 1874, inclusive, from observations at Port Austin. These water levels for Lake Huron stage, from 1860 to 1907, inclusive, are given in Table 5.

10. G. T. R. Water-level observations have been taken near the head of the St. Clair River, at G. T. R. (Grand Trunk Railway) from March, 1899 to December, 1907, inclusive. The computed G.T.R. monthly mean gage readings from January, 1860, to February, 1899, inclusive, were derived from the relation deduced between the monthly mean stage at Harbor Beach and Grand Trunk Railway, from March, 1899, to December, 1904, inclusive. The equations are: for assumed open season, from April to December, (G. T. R.—578) = 0.889 (Harbor Beach—578) — 0.529, and for the winter season of January, February and March, (G. T. R. —578) = 0.889 (Harbor Beach—578) —0.235. The actual observations showed that during the average open season the fall from Harbor Beach to G. T. R. remained practically constant for the same stage, but increased slightly with increasing stages of Lake Huron, while during the winter months the fall decreased materially but also increased slightly with increasing stages of the lake. The G.T.R. gage data are shown in Table 6.

11. St. Clair Flats Canal. In July, 1872, the first authentic records of the stage of Lake St. Clair were taken at the St. Clair Flats Canal. These readings were recorded continuously up to December, 1907, inclusive, with the exception of October, 1877; April and May, 1878; June, 1879, to August, 1881, inclusive; November, 1881, to April, 1882, inclusive; June, September, and October, 1882; December, 1882, to April, 1883, inclusive; January to March, 1902, inclusive; February to April, 1903, inclusive; January, 1906, to October, 1906, inclusive; and August, 1907, to December, 1907, inclusive. From January, 1860, to June, 1872, inclusive, no observations were taken. Values for the missing monthly mean water levels at St. Clair Flats Canal for January, 1861, to July, 1865, inclusive; January, 1866; April and May, 1878, and June, 1879, to August, 1881, inclusive, have been deduced from the monthly means of observations taken simultaneously at St. Clair Flats Canal, the Light-house Depot, Detroit, Mich. (see 1868 United States Lake Survey report in report of the Secretary of War, Fortieth Congress, third session, Vol. 2, 1868-69, p. 985), and Amherstburg, Ont., from which the derived relation between fall from Light-house Depot to Amherstburg, and fall from St. Clair Flats to Amherstburg has been determined. The equation expressing this relation is: (Fall St. Clair Flats to Amherstburg) = 1.0357 (Fall Light-house Depot to Amherstburg) + 0.377. Those missing for January, 1868, to March, 1868, inclusive; January, 1869, to March, 1869, inclusive; December, 1869, to March, 1870, inclusive; January and February, 1871; and December, 1871, to March, 1872, inclusive, have been derived from the monthly means of observations taken simultaneously at St. Clair Flats Canal, Old Detroit Waterworks, located at the foot of Orleans Street, Detroit Mich. (see Forty-ninth regular report of the Board of Water Commissioners to the Common Council of the City of Detroit, 1901), and Amherstburg, Ont., from which has been derived the relation between the fall from St. Clair Flats to Old Detroit Waterworks, and fall from St. Clair Flats to Amherstburg. The derived equation is: (Fall St. Clair Flats to Amherstburg) = 0.9378 (Fall Old Detroit Waterworks to Amherstburg) + 0.853. Those missing for August, 1865, to December, 1865, inclusive; February, 1866, to December, 1867, inclusive; April, 1868, to December, 1868, inclusive; April, 1869, to November, 1869, inclusive; April, 1870, to December, 1870, inclusive; March, 1871, to November, 1871, inclusive; April, 1872, to June, 1872, inclusive; and October, 1877, have been derived independently from Light-house Depot observations and from Old Detroit Waterworks' records

taken at the foot of Orleans Street, Detroit, Mich., as previously explained. The mean of the two derived values has been used for St. Clair Flats. For all months of the year 1860, the St. Clair Flats values (as given on p. 4097, United States Lake Survey report of 1904) have been reduced by 0.67 foot, so as to obtain the original readings taken at the Old Detroit Waterworks, foot of Orleans Street, which were not available. From the original readings thus obtained, new values for stage at St. Clair Flats Canal have been derived by the fall method previously described. The value 0.67 foot represents the mean fall from St. Clair Flats Canal to Old Detroit Waterworks, as deduced on p. 4682 of the United States Lake Survey report for 1904. The derived values for November, 1881, to April, 1882, inclusive; June, September, and October, 1882; and December, 1882, to April, 1883, inclusive, have been obtained by first subtracting 0.48 foot (0.477) from the New Detroit Waterworks' readings and then applying the mean monthly fall from St. Clair Flats to New Detroit Waterworks, as deduced from observations taken at those points from January, 1889, to June, 1901, inclusive. The value referred to above (0.48 foot) represents the discrepancy in the elevation of the zero of the New Detroit Waterworks' gage, as determined about 1878 and during the period from 1893 to 1897. In the forty-ninth regular report of the Board of Water Commissioners of Detroit, it was assumed that the error occurred when the gage was moved and that it had remained at a constant elevation from January, 1878, until 1893. A comparison of these data with those taken simultaneously at St. Clair Flats Canal indicates that the change occurred after May, 1889. Those for January to March, 1902, inclusive; February to April, 1903, inclusive; January to October, 1905, inclusive; and August to December, 1907, inclusive; have been derived from the observations taken at Windmill Point, Lake St. Clair, by applying the mean monthly fall from St. Clair Flats Canal to Windmill Point, as determined from simultaneous observations taken at those points from January, 1897, to July, 1907, inclusive. The monthly mean levels of Lake St. Clair, at St. Clair Flats Canal, are given in Table 7.

12. Windmill Point. Water-level readings have been taken at Windmill Point, near the outlet of Lake St. Clair, by the United States Lake Survey, from 1897 to 1907, inclusive, with the exception of February, 1898, and May and June, 1902. The monthly mean stage values from January, 1860, to December, 1896, inclusive, and for the three missing months mentioned above, have been derived from the St. Clair Flats Canal readings by applying to those values the mean monthly fall from St. Clair Flats Canal to Windmill Point, as determined from simultaneous observations made at those points from January, 1897, to July, 1907, inclusive. The monthly mean values at Windmill Point are given in Table 8.

13. Amherstburg. For several years, commencing with July, 1899, water-surface readings have been taken at the foot of the Detroit River, by which a good relation has been obtained between the water levels at Cleveland, Ohio, and Amherstburg, Ont. The values from January, 1860, to June, 1899, inclusive, and July to December, 1907, inclusive, were derived by applying to the Cleveland, Ohio, readings the mean monthly fall from Amherstburg to Cleveland, as determined from simultaneous observations at those places from July, 1899, to December, 1904, inclusive. The Amherstburg monthly mean water-surface readings are shown in Table 9.

14. Cleveland. Water-level readings of Lake Erie, have been taken at Cleveland, Ohio, from 1860 to 1907, inclusive, with the exception of January, 1877, and October, 1880, to March, 1881, inclusive, which values have been supplied by applying to the monthly mean values for Erie, Pa., the corresponding yearly mean difference of stage between Erie and Cleveland. The values from

January, 1860, to December, 1903, inclusive, have been taken from the United States Lake Survey report for 1904, beginning with p. 4097. Those from January, 1904, to December, 1907, inclusive, have been taken from the United States Lake Survey annual reports. These monthly mean water levels of Lake Erie, at Cleveland, Ohio, are given in Table 10.

15. Buffalo. All of the water-surface records taken at Buffalo, prior to March, 1887, were accidently destroyed, and values have been derived from Cleveland readings by applying to such readings the mean monthly fall from Cleveland to Buffalo, as derived from simultaneous observations taken at those places from June, 1899, to December, 1906, inclusive. Values for January and February, 1901, and December, 1902, have been supplied in the same way. From 1888 to 1898, inclusive, the monthly means have been derived from the U.S. Lake Survey tables by subtracting 0.1 foot from the records there given. This correction has been determined by a comparison with Cleveland of the mean of the three months, June, July, and August, for each year during this period. From March, 1899, to December, 1907, inclusive, the gage records have been taken with a self-registering automatic gage, located at the Buffalo Breakwater Light-house. The monthly mean elevations of Lake Erie, at Buffalo, N.Y., from 1860 to 1907, inclusive, are given in Table 11.

16. Charlotte. Water-level readings of Lake Ontario have been taken at Charlotte, N.Y., from January, 1860, to October, 1907, inclusive. In 1906, the United States Lake Survey's automatic gage was destroyed and since that time has not been replaced. These monthly mean water-surface elevations of Lake Ontario at Charlotte, N.Y., are given in Table 12.

17. Oswego. Water-level observations have been taken at Oswego, N.Y., from 1860 to 1907, inclusive. These water levels give the true elevations of Lake Ontario for that period, with the possible exception of some spring months when the Oswego River is at flood stage. These water-surface elevations of Lake Ontario, at Oswego, N.Y., are given in Table 13.

18. Ogdensburg. The water-level records of the St. Lawrence River, taken at Ogdensburg, N.Y., are very incomplete. The missing monthly means for Ogdensburg have been derived from Oswego readings by use of the following equation, which has been derived from monthly mean levels at those two places, as deduced from simultaneous observations: (Ogdensburg—240) = 0.9426 (Oswego—240)—0.553. The St. Lawrence River water levels, at Ogdensburg, are shown in Table 14.

19. Lock 27. The Canadian Government has observed the stage of water on the sills of the several locks in the St. Lawrence canals for many years. The observations taken at Lock 27, which is located at the head of Galop Rapids in the St. Lawrence River, date from January, 1875, and are complete to December, 1907, inclusive, with the exception of June, 1878, February, 1880, and August and September, 1890, the values for which have been derived from Oswego values, using the following formula: (Lock 27—240) = 0.9457 (Oswego—240)—1.845. For the period from January, 1860, to December, 1874, inclusive, the water-level values have been derived from Oswego, N.Y., readings according to the above formula, which assumes a mean-fall relation between Oswego and Lock 27 during that period. Table 15 gives the monthly mean water-level records of the St. Lawrence River, at Lock 27, head of Galop Rapids, from 1860 to 1907, inclusive.

20. Lock 24. The water-level readings taken at Lock 24 have been observep from January, 1880, to December, 1907, inclusive, and are complete with the exception of February, 1880, April and May, 1882, and May, 1890. Lock 24 is located at the head of the Morrisburg Canal. This canal was built along a portion of the north shore of the St. Lawrence River, and provides a 14-foot

navigable channel around the Rapide Plat. Table 16 gives the monthly water levels at Lock 24, head of Rapide Plat, St. Lawrence River, from January, 1880, to December, 1907, inclusive.

21. Lock 21. The stage observations taken at Lock 21, the upper entrance to the Cornwall Canal and at the head of the Long Sault Rapids in the St. Lawrence River, were begun January, 1870, and are complete to December, 1907, inclusive, with the exception of September, 1882. The monthly mean water-surface readings at Lock 21, Cornwall Canal, head of Long Sault Rapids, St. Lawrence River, are given in Table 17.

22. Plate 1 shows the monthly mean stage of Lakes Superior, Michigan-Huron, St. Clair, Erie, and Ontario from 1860 to 1907, inclusive.

NOMENCLATURE.

23. The following abbreviations and terms are used in this report:

S = Total supply to any lake, in cubic feet per second.
R = Run-off from watershed, in cubic feet per second.
D = Discharge of lake's outlet, in cubic feet per second.
E = Evaporation from lake surface, in cubic feet per second.
P = Precipitation on lake surface, in cubic feet per second.
I = Inflow or transmitted supply from lake above, in cubic feet per second.
L = Local supply, or supply from lake's own drainage area, in cubic feet per second.
s = Storage on lake surface, in cubic feet per second (positive or negative).
A = Area of lake, in square feet.
h = Depth, in feet, on lake surface, measured from any datum.
t = Time, in seconds, for one-twelfth of a year.
i = Increment, or rate of change of discharge in cubic feet per second per foot change in stage.
u = Coefficient.
g = Acceleration due to gravity, = 32.2 feet per second per second.
b = Width of section, or length of crest of submerged weir in feet.
h_U = Head, in feet, on crest of submerged weir, measured from upstream side.
h_D = Head, in feet, on crest of submerged weir, measured from downstream side.
F = Fall in stream, expressed in feet.
C = Coefficient.
V = Mean velocity, in feet per second.
k = Theoretical velocity head, in feet, $= V^2 \div 2g$.
h_S = Height of swell, in feet.
d = Mean depth, in feet.
$R_{MAX.}$ = Ratio between the maximum value of mean monthly discharge and the maximum value of mean monthly total supply to any lake.
$T_{MAX.}$ = Time interval in days between the date of the occurrence of the maximum value of mean monthly total supply to any lake and that of the maximum value of mean monthly discharge from that lake.
$T_{MIN.}$ = Time interval in days between the date of the occurrence of the minimum value of mean monthly total supply to any lake and that of the minimum value of mean monthly discharge from that lake.

GENERAL EQUATION FOR STREAM FLOW.

24. The discharge equations of all rivers in the Great Lakes system, with the exception of the St. Marys River, have been derived by use of a submerged-weir formula. Each river bed has been assumed to represent a submerged weir with a broad, flat crest, whose upstream and downstream faces are of considerable length. The location of the submerged weir has been assumed to be at or near the critical cross section, which is generally at the head of the river. The submerged-weir formula is generally recognized in one of the following two forms:

$$D = u\frac{2}{3}b\sqrt{2g}\left(h_U - h_D\right)^{\frac{3}{2}} + ubh_D\sqrt{2g}\left(h_U - h_D\right)^{\frac{1}{2}} \qquad (1)$$

$$D = u\frac{2}{3}b\sqrt{2g}\left(h_U + \frac{h_D}{2}\right)\left(h_U - h_D\right)^{\frac{1}{2}} \qquad (2)$$

where h_U represents the depth on the average elevation of the crest of the weir, measured from the upstream side,

h_D the depth on the average elevation of the crest of the weir, measured from the downstream side, and

b, the length of the weir crest in feet. The quantity, $(h_U - h_D)$, represents the fall (F) in the stream, or the difference between the upstream and downstream heads. The quantity, $u2.3b\sqrt{2g}$, taken as a whole, represents a variable coefficient (C) which has been derived for each river and is applicable only to that river. This submerged-weir formula reduces to the form,

$$D = CF^{\frac{1}{2}}\left(h_U + \frac{h_D}{2}\right) \tag{3}$$

and was so used in deriving the discharge equations of the several rivers. For every measurement of river discharge, all factors are known, with the exception of the coefficient, which has been derived. Knowing the way in which the coefficient for each river varies according to the upstream and downstream head, it is a comparatively simple matter to compute the discharges of the several outlets according to the proper formula. On the St. Clair, Detroit, and St. Lawrence Rivers, the coefficients vary as a function of the upstream and downstream head on the submerged weir. The curve used, showing the manner in which C varies, is the equilateral hyperbola, with its asymptotes parallel to the co-ordinate axes. It is:

$$C = \frac{y}{1 + \frac{x}{h_U}} \tag{4}$$

in which C is the coefficient depending on h_U or h_D, the upstream or downstream head, respectively.

x and y are constants, which represent the distance of the asymptotes from the y and x axes, respectively.

For convenience in deriving the unknown values, this hyperbolic equation has been transformed into a straight-line equation by dividing by y, which gives

$$C = \frac{1}{\frac{1}{y} + \frac{x}{yh_U}} \tag{5}$$

and then taking the reciprocal of each member:

$$\frac{1}{C} = \frac{1}{y} + \frac{x}{y}\left(\frac{1}{h_U}\right) \tag{6}$$

DISCHARGE OF ST. MARYS RIVER, OUTLET TO LAKE SUPERIOR.

25. The St. Marys River, from Point Iroquois, in Lake Superior, to the head of the United States Ship Canal, at Sault Ste. Marie, Mich., is a wide stream with comparatively little slope, there being about two-tenths of a foot fall in this distance. At the latter location, rapids (about one-half a mile in length) connect the upper and lower St. Marys River. The submerged weir of rock at the head of these rapids controls the discharge of water from Lake Superior, and any change in this submerged weir would cause a change in the volume of discharge for the same stage. Any auxiliary channel connecting with the pool immediately above the weir would increase the river discharge for the same stage by the volume thus diverted. During the epoch, 1860 to 1907, inclusive, the regimen of the St. Marys River, above the rapids, was changed on several occasions. In 1887 and 1888, the International Bridge across the St. Marys Rapids was constructed. Prior to that time, the river discharged at the bridge site through four channels, viz., the main rapids and three small streams situated between the islands lying adjacent to the north shore. The building of the bridge piers and approaches and the filling in of portions of the three small streams (called *a*, *b*, and *c*) on the north side of the main channel reduced the effective area at this critical discharge cross section so that the flow of the St. Marys River was materially decreased.

26. In 1889, the Canadian Water Power Company (now the Lake Superior Power Company) commenced work on a power plant and used for its canal the northerly of the three small streams (*c*) previously mentioned. The flow therein was practically stopped until the latter part of 1895, when this power plant was opened. During the year 1892, the Edison Sault Electric Light & Power Company (now the Chandler-Dunbar Water Power Company) built a dyke from the second pier on the American side of the International Bridge, parallel to the shore, for a distance of about 1,500 feet down the stream. The area inclosed by the American shore and this dyke is used as a forebay by the power company, practically shutting off from the main channel the flow through these two spans. By December, 1892, the flow of the river had been restricted by the building of the piers and approaches to the International Bridge, the shutting off of spans 1 and 2 from the main channel on the American side, and the closing of stream *c* on the Canadian side. Beginning in December, 1895, the Lake Superior Power Company started the operation of its plant on a large scale, using water at the rate of approximately 3800 cubic feet per second. This power plant has been in continuous operation since then, with the exception of February and March, 1896, and has gradually increased the quantity of water used until it now reaches about 6000 cubic feet per second. The use of water by the American and Canadian locks has also increased from time to time until it now amounts to an average flow of about 600 cubic feet per second. In 1901, the Michigan Lake Superior Power Company started work on the construction of a compensating works in the rapids of the St. Marys River, about 300 feet above the International Bridge. These works practically shut off the entire flow through spans 9 and 10, the first two spans on the Canadian side of the river. In January, 1905, the Michigan Lake Superior Power Company began to divert water through its canal, using about 8500 cubic feet per second at that time.

27. Discharge Measurements. During the winter of 1896, discharge measurements of the St. Marys River were taken by the United States Government at Spry's Dock Section, located about a mile below the St. Marys Rapids. The discharge equation deduced from these observations, modified for the various efflux conditions, has been the governing factor for the determination of the outflow of Lake Superior from January, 1860, to September, 1901, inclusive. The derived equation is:

$$D_{RIVER} = 18826\ (\text{Southwest Pier Gage} - 600) + 37060. \qquad (7)$$

See 1906 United States Lake Survey report (unpublished).

28. The Southwest Pier Gage is located at the southwest pier above the American locks at Sault Ste. Marie, Mich. At the time that these measurements were taken, the Chandler-Dunbar Water Power Company was using 1065 cubic feet of water per second through its works; streams *a* and *b* on the north side of the main channel were still open, and the Lake Superior Power Company's plant was closed.

29. In 1902, the United States Lake Survey measured the flow through the St. Marys Rapids at the International Bridge, which connects Sault Ste. Marie, Mich., with Sault Ste. Marie, Ont. The discharge equation derived from these observations gives the flow through the rapids after spans 9 and 10 (the first two spans on the Canadian side) were closed by the construction of the compensating works of the Michigan Lake Superior Power Company. It is:

$$D_{RAPIDS} = 15540\ (\text{Southwest Pier Gage} - 600) + 30510. \qquad (8)$$

30. During February and March, 1905, observations of the flow in the St. Marys River were taken at "Section Brewery," located about 2000 feet below the Spry's Dock Section. The discharge equation derived from these measurements is:

$$D_{RIVER} = 18484\ (\text{Southwest Pier Gage} - 600) + 41829. \qquad (9)$$

This formula gives the total flow of the river, while that derived from the 1902 measurements gives only the flow through the St. Marys Rapids.

31. St. Marys River Discharge Formulae, as Used for the Different Efflux Conditions. The discharge formula governing the first period, 1860-1888, inclusive, was derived from the measurements made in 1896 and 1902 (the fifth and tenth periods of efflux) in conjunction with hydraulic data taken at the International Bridge Section in 1901 and 1902. The mean stage of the St. Marys River at the Southwest Pier (above the locks), Sault Ste. Marie, Mich., from 1871 to 1905, inclusive, was 601.86 feet above mean tide at New York. The 1896 discharge measurements give: $D_{RIVER} = 18826$ (Southwest Pier Gage -600) $+ 37060$. The discharge of the river at mean stage was 72076 cubic feet per second. Deducting from thic value 1065 cubic feet per second (the amount of water used by the Chandler-Dunbar Water Power Company) and 1798 cubic feet per second (the discharge of two small streams on the north side of the rapids) gives the flow through the main channel of the St. Marys Rapids as 69200 cubic feet per second. From the vertical and transverse percentage velocity cyrves deduced from observations made at the Bridge Section, for spans 3-10, inclusive, in 1901, and for spans 3-8, inclusive, in 1902, the ratio of flow of the entire cross section to that for any partial section has been determined. These curves show the modification in the transverse velocity curve due to the construction, by the Michigan Lake Superior Power Company, of the compensating works located about 300 feet above the bridge. With these data, the transverse percentage velocity curve at the International Bridge Section, for the first period, has been constructed for the entire main channel, which included the channels for spans 1 and 2 of the bridge, next the American shore. This curve has been integrated and its mean ordinate, or mean percentage velocity, computed. The product of this value and the mean velocity of the rapid's flow at mean river stage under the 1896 conditions, or during the fifth period of efflux, gives the mean velocity for the main channel under the original conditions or for the first period of efflux. The product of the mean velocity and the area of the cross section before the bridge was built gives the discharge of the main channel for mean river stage. The equations giving the actual computations are:

$$D_1 = A_1 \left(\frac{D_5}{A_5} \times \text{mean percentage } V_1\right) = A_1 \; V_1 \qquad (10)$$

$$= 13690 \left(\frac{69200}{10650} \times 0.925\right) = 13690 \times 6.01 = 82280 \text{ cubic feet per}$$

second, discharge of main channel for mean river stage under original conditions.

32. With the volume of flow known for mean river stage, the only remaining step is to derive the increment of discharge per foot change in stage. In deriving this increment, use has been made of Bernouilli's theorem applied to open channels with steady flow, expressed as follows:

$$\text{Friction head} = F + \frac{V^2_{\text{UPSTREAM}}}{2g} - \frac{V^2_{\text{DOWNSTREAM}}}{2g} \qquad (11)$$

33. It has been assumed that the friction heads before and after the rise were proportional to the squares of the respective velocities at the Bridge Section. The two cross sections used are: The upper one, located nearly opposite the Southwest Pier Gage, and the lower one, at the International Bridge. Under original conditions, the areas of the upper and lower cross sections were 46260 and 13690 square feet, respectively, and the widths were 3400 and 2383 feet, respectively, at 601.86 feet, the mean river stage at Southwest Pier Gage. According to formula 10, the discharge of the river at this stage was 82280 cubic feet per second. The corresponding mean water surface at the Bridge

Section was 600.56 feet. Substituting these values in the preceding formula gives: Friction head before rise = 1.30 + 0.049—0.562 = 0.787 foot. Actual measurements taken under the conditions existing for the fifth and tenth periods show that a rise of 1 foot at Southwest Pier Gage for mean river stage caused a rise of 0.636 and 0.592 foot at the bridge, respectively. These are the values for rise before and after the compensating works had been constructed. The mean of the above values (0.614 foot) has been used as the assumed rise under original conditions, since the relation appeared to be nearly constant for two radically different discharge periods. After a rise of 1 foot at the upstream section, the mean velocity became $\frac{D}{49660}$ feet per second, and the corresponding velocity head was $\frac{(\frac{D}{49660})^2}{2g}$. For the rise of 0.614 feet at the downstream section, the mean velocity became $\frac{D}{15150}$ feet per second, and the corresponding velocity head was $\frac{(\frac{D}{15150})^2}{2g}$. The potential head after rise was: F = 1.30 + 1.00—0.614 = 1.686 feet. Substituting the new values in Bernouilli's formula gives: Friction head after rise $= 1.686 + \frac{(\frac{D}{49660})^2}{2g} - \frac{(\frac{D}{15150})^2}{2g}$. Under the previous assumption that the friction heads before and after the rise were proportional to the square velocities, we have:

$$0.787 : 1.686 + \frac{(\frac{D}{49660})^2}{2g} - \frac{(\frac{D}{15150})^2}{2g} :: 6.01^2 : (\frac{D}{15150})^2 \qquad (12)$$

whence D = 103840 cubic feet per second. This value represents the discharge through the main channel at 1 foot above mean river stage, 601.86. The difference between this discharge value and 82280, the discharge for mean stage, is 21560 cubic feet per second, the increment of discharge for 1 foot rise above mean stage. This method was also used for the determination of the increment for one foot below mean stage, which gave 20720. The mean of 21560 and 20720, viz., 21140 cubic feet per second, has been used as the increment of discharge.

34. The discharge formula governing the flow through the main channel for the first period is as follows:

$$D_{1\ \text{MAIN CHANNEL}} = 21140\ (\text{Southwest Pier Gage} - 601.86) + 82280. \qquad (13)$$

35. The two small streams (*a* and *b*) situated on the north side of the main channel had a flow of 1800 cubic feet per second at mean river stage, with an estimated increment of discharge per foot rise of 950 cubic feet per second. The third small stream (*c*) situated also on the north side of the main channel had an estimated flow of 1800 cubic feet per second at mean river stage, with an estimated increment of discharge per foot rise of 950 cubic feet per second. By combining the above results, the discharge formula of the St. Marys River for the original conditions, or first period (January, 1860, to November, 1888, inclusive), before any alterations had occurred in the outlet to Lake Superior above the St. Marys Rapids, is:

$$D_1 = 23040\ (\text{Southwest Pier Gage} - 601.86) + 85880. \qquad (14)$$

36. The construction of any engineering structure necessarily takes time; so, in the building of the piers and approaches for the International Bridge, some time elapsed before the completion of the substructure. It is assumed that original conditions prevailed to December 1, 1888, after which the piers and approaches for the International Bridge are considered as having been com-

pleted, and stream *c*, adjacent to the north shore, as having been closed. This date marks the beginning of the second period, which is assumed to continue to December, 1892, inclusive, The discharge formula governing the flow through the main channel for this efflux condition has been computed in the same way as that for the first period. It is:

$$D_{2\ \text{MAIN CHANNEL}} = 19080\ (\text{Southwest Pier Gage} - 601.86) + 77200. \quad (15)$$

37. Two small streams (*a* and *b*) situated on the north side of the main channel were still flowing, as in the first period. Combining the results of the flow through the main channel and streams *a* and *b* gives the total flow in the St. Marys River for the second period as:

$$D_2 = 20030\ (\text{Southwest Pier Gage} - 601.86) + 79000. \quad (16)$$

38. For the third period, January, 1893, to November, 1895, inclusive, the efflux condition was the same as that for February and March, 1896, when the discharge measurements were taken. It is assumed that the Chandler-Dunbar Water Power Company closed spans 1 and 2, on the American end of the International Bridge, at the beginning of this period. The volume of water used by them was estimated to be about 1065 cubic feet per second. Streams *a* and *b* were still flowing. The equation of discharge for St. Marys River for the third efflux condition is:

$$D_3 = 18826\ (\text{Southwest Pier Gage} - 600) + 37060. \quad (17)$$

39. In December, 1895, the beginning of the fourth period, the Lake Superior Power Company began using water on a large scale, estimated by the chief engineer of the Lake Superior Power Company at 3800 cubic feet per second. The Chandler-Dunbar Water Power Company is assumed to have been still using 1065 cubic feet per second. Streams *a* and *b* were still flowing. The discharge equation for the fourth period, from December, 1895, to January, 1896, inclusive, is:

$$D_4 = 18826\ (\text{Southwest Pier Gage} - 600) + 40860. \quad (18)$$

40. The fifth epoch, February and March, 1896, marks the date of the first discharge measurements of the St. Marys River used in this report. The discharge formula for the river flow is:

$$D_5 = 18826\ (\text{Southwest Pier Gage} - 600) + 37060. \quad (19)$$

41. For the sixth period, April, 1896, to December, 1897, inclusive, the auxiliary flow is estimated at 3500 cubic feet per second through the works of the Lake Superior Power Company. Streams *a* and *b* were still open. The Chandler-Dunbar Water Power Company was using approximately 1065 cubic feet per second. The three latter are included in the river discharge formula as derived from observations made in February and March, 1896. The discharge equation of the St. Marys River for this period is:

$$D_6 = 18826\ (\text{Southwest Pier Gage} - 600) + 40560. \quad (20)$$

42. For the seventh period, January, 1898, to March, 1899, inclusive, 4000 cubic feet per second is estimated as the side flow through the works of the Lake Superior Power Company. Streams *a* and *b* were still flowing. The Chandler-Dunbar Water Power Company is estimated to have been still using about 1065 cubic feet per second. The discharge through the locks for this period and previous thereto has not been incorporated in the discharge equations, owing to the fact that it is considered to have been, comparatively, a small quantity. The discharge equation giving the flow of the St. Marys River for this period is:

$$D_7 = 18826\ (\text{Southwest Pier Gage} - 600) + 41060. \quad (21)$$

43. For the eighth period, April, 1899, to December, 1899, inclusive, the side flow through the works of the Lake Superior Power Company is estimated

at 4000 cubic feet per second. Streams *a* and *b* were still flowing. The Chandler-Dunbar Water Power Company is assumed to have increased its flow at the beginning of the period from 1065 cubic feet per second to 1400 cubic feet per second. It is estimated that the American and Canadian locks were using at that time an average flow of 600 cubic feet per second. By combining the above data, the net side flow, other than that at the time of the 1896 discharge measurements, $=4000+(1400-1065)+600=4935$ cubic feet per second, (4940 used). The discharge formula for the St. Marys River for this period is:

$$D_8 = 18826 \text{ (Southwest Pier Gage} - 600) + 42000. \quad (22)$$

44. For the ninth period, January, 1900, to September, 1901, inclusive, streams *a* and *b* are assumed to have been closed at the beginning of the epoch. The shutting of these two channels decreased the increment of discharge per foot rise by 950 cubic feet per second, or to 17880, but did not change the total discharge for the main channel at stage 600 on account of the discharge of streams *a* and *b* being approximately zero at this stage. The side flow through the works of the Lake Superior Power Company is estimated to have been 5000 cubic feet per second. The Chandler-Dunbar Water Power Company and the American and Canadian locks are assumed to have been using 1400 and 600 cubic feet per second, respectively. By combining the above data, the net side flow of the river, other than that at the time of the 1896 measurements, was: $5000+(1400-1065)+600=5935$ cubic feet per second (5940 used). The discharge formula for the St. Marys River for this period is:

$$D_9 = 17880 \text{ (Southwest Pier Gage} - 600) + 43000. \quad (23)$$

45. For the tenth period, October, 1901, to December, 1904, inclusive, the discharge formula derived from the measurements taken at the International Bridge in 1902, after the compensating works had been constructed by the Michigan Lake Superior Power Company, is:

$$D_{10\ \text{MAIN CHANNEL}} = 15540 \text{ (Southwest Pier Gage} - 600) + 30510. \quad (24)$$

46. This equation represents the flow through the St. Marys Rapids and does not take into account the flow through the Chandler-Dunbar Water Power Company's forebay and plant. Previous to this period, the quantity of water used by the Chandler-Dunbar Water Power Company is considered directly in the discharge equation. The side flow through the works of the Lake Superior Power Company is estimated to have been 5000 cubic feet per second. The Chandler-Dunbar Water Power Company and the American and Canadian locks are estimated to have been using about 1400 cubic feet per second and 600 cubic feet per second, respectively. The discharge formula of the St. Marys River, used for this efflux condition, is:

$$D_{10} = 15540 \text{ (Southwest Pier Gage} - 600) + 37510. \quad (25)$$

47. For the eleventh period, January, 1905, to December, 1907, inclusive, the discharge formula depends on discharge measurements made by the United States Lake Survey in February and March, 1905, at "Section Brewery," located about 2000 feet below Spry's Dock Section, which was situated opposite the power house belonging to the Michigan Lake Superior Power Company. During this period, the side flow through the works of the Lake Superior Power Company, the Michigan Lake Superior Power Company, the Chandler-Dunbar Water Power Company, and the American and Canadian locks is estimated at 6000, 8500, 1400, and 600 cubic feet per second, respectively. The discharge formula giving the total flow of the river for this period, based on the 1905 measurements, is:

$$D_{11} = 18484 \text{ (Southwest Pier Gage} - 600) + 41830. \quad (26)$$

48. It has been noted that the discharge formulæ for efflux periods 10 and 11 show a difference in the increment of discharge of 2944 cubic feet per second

for substantially the same conditions, the only known change in the regimen being an assumed constant diversion of 8500 cubic feet per second through the canal of the Michigan Lake Superior Power Company. This difference in increment is probably due in part to greater leakage at high stage through the dam of the Chandler-Dunbar Water Power Company.

49. The following table gives a summary of the discharge equations for the St. Marys River for the several efflux periods:

TABLE 18.

SUMMARY OF THE ST. MARYS RIVER DISCHARGE EQUATIONS FOR THE DIFFERENT EFFLUX CONDITIONS.

No. of Period	Length of Period	Discharge Equation, St. Marys River
1	Jan. 1860—Nov. 1888	D_1 =23040 (Southwest Pier Gage—601.86) +85880
2	Dec. 1888—Dec. 1892	D_2 =20030 (Southwest Pier Gage—601.86) +79000
3	Jan. 1893—Nov. 1895	D_3 =18826 (Southwest Pier Gage—600.00) +37060
4	Dec. 1895—Jan. 1896	D_4 =18826 (Southwest Pier Gage—600.00) +40860
5	Feb. 1896—Mar. 1896	D_5 =18826 (Southwest Pier Gage—600.00) +37060
6	Apr. 1896—Dec. 1897	D_6 =18826 (Southwest Pier Gage—600.00) +40560
7	Jan. 1898—Mar. 1899	D_7 =18826 (Southwest Pier Gage—600.00) +41060
8	Apr. 1899—Dec. 1899	D_8 =18826 (Southwest Pier Gage—600.00) +42060
9	Jan. 1900—Sep. 1901	D_9 =17880 (Southwest Pier Gage—600.00) +43000
10	Oct. 1901—Dec. 1904	D_{10} =15540 (Southwest Pier Gage—600.00) +37510
11	Jan. 1905—Dec. 1907	D_{11} =18484 (Southwest Pier Gage—600.00) +41830

Southwest Pier Gage gives the elevation of the water surface of St. Marys River at Southwest Pier, above the locks, Sault Ste. Marie, Mich., above mean tide at New York.

50. The monthly mean discharge values of the St. Marys River, from January, 1860, to December, 1907, inclusive, are given in Table 19.

51. PROBABLE EFFECT UPON MEAN LEVEL OF LAKE SUPERIOR OF OBSTRUCTIONS IN ST. MARYS RIVER AT HEAD OF RAPIDS. Any obstruction placed in a river at or near its critical or controlling discharge section changes the volume of flow and affects the level of the lake above and also the levels of those below. The construction of the piers and approaches of the International Bridge changed the discharge of the river and raised the mean level of Lake Superior. The shutting off of spans 1 and 2 on the American side, from the main channel, by the Chandler-Dunbar Water Power Company, and the construction of the compensating works by the Michigan Lake Superior Power Company have also had their effect on the level of Lake Superior and the lower lakes. The ultimate effect of these obstructions placed in the main channel has been derived for mean river stage on the assumption that no diversions have been made by the Lake Superior Power Company or the Michigan Lake Superior Power Company. This maximum effect on lake levels has not entirely taken place, owing to these diversions by the said power companies. In treating this subject, use has been made of the incomplete-weir formula, river-discharge increments and river-gage relations. The discharge through the main channel of the St. Marys Rapids for the third to ninth periods, inclusive, for mean river stage at Southwest Pier Gage, (1871 to 1905, inclusive), 601.86, has been previously computed as 69200 cubic feet per second. The corresponding measured mean water surface at the International Bridge Section during this period of flow was 600.61. In 1902, after the compensating works of the Michigan Lake Superior Power Company were built, practically closing spans 9 and 10, the mean water surface of this section was measured as 600.98 for the same discharge, 69200 cubic feet per second. This rise of 0.37 foot in the water surface represents the swell, h_s, at the International Bridge Section, due to the shutting off by the compensating works of the two spans on the Canadian side of the rapids. These actual

measurements afford a means for determining an experimental value of u in the incomplete-weir formula :

$$D = u\, b \sqrt{2g} \left\{ \frac{2}{3} \left[(h_s + k)^{\frac{3}{2}} - k^{\frac{3}{2}} \right] + d\,(h_s + k)^{\frac{1}{2}} \right\} \quad (27)$$

where D = 69200 cubic feet per second, the discharge through the St. Marys Rapids, in third to ninth periods, inclusive, with mean water surface at International Bridge of 600.61, and in tenth period with mean water surface of 600.98, b_A = 1511 feet, width of channel after obstruction by compensating works,

2g = 64.4 feet per second per second,

h_s = height of swell, in feet.

$k = \frac{V^2}{2g} = \frac{(D\ A_B)^2}{2g} = 0.655$ foot = theortical velocity head previous to placing of obstruction, and where A_B is area of cross section of main channel before compensating works were built = 10650 square feet.

$d = \frac{A_B}{b_B} = \frac{10650}{1794} = 5.937$ feet = mean depth previous to construction of works, where b_B is width of channel in third to ninth periods, inclusive. Substituting these values in the above equation and solving gives a value for u of 0.899. The building of the piers and approaches of the International Bridge, according to computations, reduced the discharge through the main channel from 82280 to 77200 cubic feet per second, decreased the channel width from 2383 to 2232 feet, and changed the cross-sectional area from 13690 to 12490 square feet. Substituting these values in the incomplete-weir formula and using the experimental value of u (0.90) gives the swell, h_s, at the bridge site, due to the construction of the piers and approaches, as 0.183 foot. The corresponding rise at Southwest Pier was 0.298 foot. This latter value represents the estimated rise in mean lake level caused by the building of the International Bridge. About four years after the International Bridge was built, the Chandler-Dunbar Water Power Company shut off spans 1 and 2, on the American side, from the main channel. This obstruction reduced still more the mean discharge through the main channel. Using the incomplete-weir formula,

$$D = u\, b \sqrt{2g} \left\{ \frac{2}{3} \left[(h_s + k)^{\frac{3}{2}} - k^{\frac{3}{2}} \right] + d\,(h_s + k)^{\frac{1}{2}} \right\}$$

for determining the effect of building the bridge piers and approaches and closing spans 1 and 2, where D = 82280 cubic feet per second, discharge at mean river level, 601.86, under original conditions,

u = 0.90, experimental coefficient for present case,

b_A = 1794 feet, width of channel after obstructions were built,

2g = 64.4 feet per second per second,

$k = \frac{V^2}{2g} = \frac{(D\ A_B)^2}{2g} = 0.562$ feet, theoretical velocity head previous to placing of obstructions, where A_B is area of cross section of main channel before structures were placed = 13690 square feet.

$d = \frac{A_B}{b_B} = 5.745$ feet = mean depth before structures were placed, where b_B = 2383 feet,

and solving for h_s gives 0.496 foot as the swell at the Bridge Section due to the construction of these works. The discharge formula for the flow through the main channel of the rapids, after the bridge piers and approaches were built and spans 1 and 2 were closed, according to 1896 measurements, is: $D_{RAPIDS\ 3\ 9}$ = 17880 (Southwest Pier Gage − 600.00) + 35995, while that after the com-

pensating works were built, according to the 1902 measurements, is: $D_{\text{RAPIDS }10} = 15540$ (Southwest Pier Gage -600.00) $+30510$. The increment at Southwest Pier Gage, as determined in 1896 and 1902, is 17880 and 15540, respectively, while that at the Bridge Section for the 1896 conditions was unknown, and for 1902 was 22600. In order to determine the increment at the bridge, under the 1896 conditions, the assumption has been made that the increments of discharge per foot rise under the same efflux conditions are directly proportional for various points in a stream. This proportion is: Increment Southwest Pier_{10}: increment Southwest Pier_{3-9} :: increment Bridge_{10} : increment Bridge_{3-9} or, inserting values, 15540 : 17880 :: 22600 : X. Solving: $X = 26000$. The difference between the discharge through the main channel in the rapids for the first period and the third-ninth period is $82280 - 69200 = 13080$ cubic feet per second. This quantity represents the volume of water cut off by the construction of the bridge piers and approaches and closing of spans 1 and 2. Since 1 foot rise at the bridge, under original conditions, is equivalent to an increase in discharge of 26000, then the swell caused by these obstructions, involving a reduction in discharge of 13080 cubic feet per second, is $\frac{13080}{26000} = 0.503$ foot. The swell at the bridge, due to the building of the piers and approaches for the International Bridge, the shutting off of spans 1 and 2 by the Chandler-Dunbar Water Power Company, and the closing of spans 9 and 10 by the construction of the compensating works, computed by the incomplete-weir formula, is 0.817 foot. Subtracting 0.37 foot, the actual measured swell due to the building of the compensating works, gives 0.447 foot as the swell at the Bridge Section due to the building of the piers and approaches of the International Bridge and the shutting off of spans 1 and 2.

52. Summarizing: The swell at the Bridge Section, due to the construction of the piers and approaches and shutting off of spans 1 and 2, is:

Incomplete weir (direct)	0.496 foot
Increment	.503 foot
Incomplete weir (indirect) $0.817 - 0.370$	.447 foot
Mean swell	.482 foot

53. The above value represents the swell at the bridge due to these obstructions, but it does not represent the true effect on the St. Marys River at Southwest Pier. Since the increment of discharge at Southwest Pier is 17880, the swell at that point, due to decreasing the discharge through the rapids by 13080, is $\frac{13080}{17880} = 0.732$ foot. By water-surface relations between Southwest Pier and mean water surface at Bridge, it is found that for mean river stage (601.86) at Southwest Pier, the corresponding mean water surface at Bridge is 600.613. Adding 0.482 foot, the mean swell at the bridge due to the construction of the piers and approaches and shutting off of spans 1 and 2, gives 601.095 as the new mean water surface. The gage reading at Southwest Pier, corresponding to this mean water surface at the bridge, is 602.645. The difference between 602.645 and 601.86 is 0.785, the swell due to building these obstructions.

54. Summarizing: The swell at Southwest Pier, due to building the piers and approaches for the International Bridge and shutting off of spans 1 and 2, is:

Increment method	0.732 foot
Gage relations	.785 foot
Mean	.758 foot

55. During the period immediately following the building of the compensating works, the mean water surface at the Bridge Section was 600.54 for mean river stage. The rapids discharge, corresponding to this gage height, was

59300 cubic feet per second. The difference between the mean rapid's discharge before and after the building of these works is computed to be 69200 − 59300 = 9900 cubic feet per second. The increment of discharge at the bridge, as determined by measurement, was 22600. From these data, the swell at the bridge is computed to be $\frac{9900}{22600} = 0.439$ foot. Actual measurements taken before and after the compensating works were built give the swell at the bridge as 0.37 foot.

56. Summarizing: The swell at the Bridge Section, due to the construction of the compensating works, is:

Increment (direct)	0.439 foot
Actual measurement	.370 foot
Incomplete weir (indirect, 0.817 — 0.482)	.335 foot
Mean	.381 foot

57. The swell at the southwest pier for this period, computed by the increment method, is $\frac{9900}{15540} = 0.638$ foot, while by gage relations it was 0.648 foot. The mean of these two values gives 0.643 foot as the rise in the mean river stage at the southwest pier, due to the compensating works.

58. SUMMARY. The mean stage of St. Marys River at the southwest pier, from 1871 to 1905, inclusive, is 601.86. The effect of the building of the piers and approaches to the International Bridge and the shutting off of spans 1 and 2 on the American shore by the Chandler-Dunbar Water Power Company was to raise the mean river level at the southwest pier 0.758 foot, or to an elevation of 602.618. The effect of the construction of the compensating works on the mean river level at Southwest Pier was to raise it 0.643 foot, or to a new mean river stage of 603.261. The mean water surface at the International Bridge, after the compensating works were built, corresponding to 603.261 at Southwest Pier, was 601.423 feet. Subtracting from this value the swell at the bridge, due to the compensating works, namely, 0.381 foot, gives the mean water surface at the bridge, before the compensating works were built, as 601.042. Subtracting from this new value 0.482 foot, the swell at the Bridge Section due to the construction of the piers and approaches to the International Bridge, and the shutting off of spans 1 and 2 from the main channel, gives 600.56 as the original mean water surface at the Bridge Section. The effect of placing obstructions in the St. Marys River at or near the International Bridge site has been to raise the mean level of the river at the bridge and Southwest Pier, and also the mean level of Lake Superior. If no diversions from the upper river had occurred, the ultimate rise in the mean level of the St. Marys River and Lake Superior would have been approximately 1.40 feet; but, owing to diversions having taken place, this rise has been diminished.

ST. CLAIR RIVER DISCHARGE.

59. During the period from April, 1899, to September, 1902, inclusive, the United States Lake Survey measured the discharge of the St. Clair River, the outlet to Lake Huron, in the vicinity of Port Huron, Mich. These measurements have been used in deriving a formula for the flow of this river in terms of G.T.R. and Dry Dock gage heights. The elevation of the crest of the submerged weir has been assumed at 543 feet above mean sea level. The St. Clair River discharge formula, as derived, is:

$$D = \left(\frac{C_{G.T.R} + C_{D.D.}}{2} \right) F^{\frac{1}{2}} \left(h_c + \frac{h_D}{2} \right) \qquad (28)$$

in which the coefficients depending on the stage at G.T.R. and Dry Dock, derived from the discharge measurements, are:

$$C_{G.T.R.} = \frac{2700.316}{\frac{62.871}{h_U} - 1}, \text{ and } C_{D.D.} = \frac{2766.21}{\frac{61.982}{h_D} - 1}, \text{ respectively.}$$

60. This discharge equation of the St. Clair River, depending on the gage readings at G.T.R. and Dry Dock, has been transformed to one depending on G.T.R. and St. Clair Flats, on account of the long series of readings taken at the St. Clair Flats Canal. In order to substitute the St. Clair Flats Canal readings for Dry Dock readings in the discharge formula, the following equation was used: (Fall, G.T.R. to St. Clair Flats Canal) = 7.4482 (Fall, G.T.R. to Dry Dock) −1.9657. The St. Clair River discharge formula, as transformed, is:

$$D = \frac{C_{G.T.R.} + C_{ST.\ CLAIR\ FLATS\ CANAL}}{2} F^{\frac{1}{2}} \left(h_U + \frac{h_D}{2}\right). \qquad (29)$$

The coefficients derived in this transformed equation are:

$$C_{G.T.R.} = \frac{1308.339}{\frac{64.674}{h_U} - 1}, \text{ and } C_{ST.\ CLAIR\ FLATS\ CANAL} = \frac{1445.118}{\frac{59.123}{h_D} - 1}.$$

61. This last equation, expressed in terms of St. Clair Flats and G.T.R., has been used to compute the mean discharges of St. Clair River from 1860 to 1907, inclusive.

62. In 1900, the Chicago Drainage Canal began diverting water from Lake Michigan. The quantity used from 1900 to June, 1904, inclusive, has been computed from data furnished the Commission by the United States Engineer Office at Chicago. The flow through the canal for the last half of the year 1904, and 1905, 1906 and 1907, has been assumed to be the quantity authorized in the permit of the Secretary of War.

DETROIT RIVER DISCHARGE.

63. The Detroit River discharge equation has been derived from measurements taken at Fort Wayne, Mich., by the United States Lake Survey during the summers of 1901 and 1902. The elevation of the crest of the weir is assumed as 540 feet above mean sea level. A part of these observations were rejected owing to the fluctuation in the level of water at Amherstburg during the discharge measurement. The remaining discharges were used in determining the discharge equation. The discharge formula, as derived, is:

$$D_{DETROIT} = \frac{C_{W.PT.} + C_{AMH.}}{2} F^{\frac{1}{2}} \left(h_U + \frac{h_D}{2}\right). \qquad (30)$$

in which $C_{W.PT.}$ for the upstream head at Windmill Point $= \frac{1174.5}{\frac{52.248}{h_U} - 1}$.

$C_{AMH.}$ for the downstream head at Amherstburg $= \frac{2052.9}{\frac{60.083}{h_D} - 1}$,

F = fall, Windmill Point to Amherstburg,
h_U = upstream head on crest of submerged weir, determined by Windmill Point gage heights,
h_D = downstream head on crest of submerged weir, determined by Amherstburg gage heights.

64. Owing to the lack of sufficient observations, no winter discharge formulæ have been derived for the Detroit or St. Clair Rivers. It is, undoubtedly, true

that for the same slope the discharge is less with an ice covering than without one, on account of the increased friction.

Ice gorges occur in the St. Clair and Detroit rivers nearly every winter, creating an abnormal slope in the river that is gorged. Under such conditions, the discharge value computed from the river not gorged, has been used as the correct monthly mean inflow to Lake Erie.

65. The monthly mean discharge values of the Detroit River from January, 1860, to December, 1907, inclusive, are given in Table 20.

NIAGARA RIVER DISCHARGE.

66. The discharge of the Niagara River has been determined by measurements taken at the International Bridge, located at Buffalo, N.Y., and at a point about 1,800 feet down stream at the "Open Section." These observations were begun in 1897 under the direction of E. E. Haskell, Engineer for the United States Deep Waterways Commission. At the conclusion of this work, the United States Lake Survey continued the measurements in 1898, 1899, and 1900. These measurements have been reduced on the assumption that the outlet of Lake Erie is a submerged weir with a broad, flat crest, whose upper nappe is about one mile in length and the lower one about two, with the crest section at or near the Buffalo Waterworks' Intake Pier. The Niagara River discharge formula, as derived, is:

$$D_{NIAGARA} = CbF^{\frac{1}{2}} \left(h_U + \frac{h_D}{2} \right). \qquad (31)$$

in which F = fall from Buffalo Breakwater Light-house, in Lake Erie, to Austin Street, in Niagara River,

h_U = upstream head on crest of submerged weir, determined by Buffalo Breakwater Light-house gage,

h_D = downstream head on crest of submerged weir, determined by Austin Street gage,

$C = -0.02458h_U + 2.550$,

556.35 = the average elevation of the crest of the weir above mean tide at New York,

b = width of crest section, at Waterworks' Intake, which is determined as follows: Compute the mean fall in the Niagara River from Buffalo Breakwater Light-house to Austin Street, according to the formula, $F = 0.02976X^2 - 0.4896X + 6.5828$, in which X = Lake Erie stage at Buffalo Breakwater Light-house gage above elevation 560 feet. Substitute this value for fall, or the actual fall between these two points in the equation, (Fall, Buffalo Breakwater Light-house to Waterworks' Intake = 0.4916 (Fall, Buffalo Breakwater Light-house to Austin Street) + 0.6553, and solve for fall from Buffalo Breakwater Light-house to Waterworks' Intake Section. Determine the corresponding stage of water at Waterworks' Intake Section by subtracting the fall from Buffalo Breakwater Light-house to Waterworks' Intake Section from Lake Erie stage as measured at Buffalo Breakwater Light-house. Then substitute in the equation, b = 80 (Waterworks' Intake stage above mean tide at New York) − 43598, and solve for the width of the crest section.

The monthly mean discharge values of the Niagara River, from January, 1860, to December, 1907, inclusive, are given in Table 21.

ST. LAWRENCE RIVER DISCHARGE.

67. The St. Lawrence River discharge formula has been determined from discharge measurements made by the United States Lake Survey in 1901 and 1902 at "Three Points Section," situated about 15 miles below Ogdensburg, N.Y., and 9 miles below the head of the Galop Rapids. During the measurements, no

simultaneous gage readings were observed at Lock 27. Since the discharge equation is expressed in terms of Ogdensburg and Lock 27 gage heights, the latter have been computed for each measurement according to the equation, (Ogdensburg − 240) = 0.0006489 (Lock 27 − 240)^2+ 0.97085 (Lock 27 − 240) + 1,3502, which was derived from simultaneous monthly mean readings taken at the two places. This method was deemed most accurate, for, during the months when observations were taken, the slope between Ogdensburg and Lock 27 approximated very closely the mean slope computed by the above formula. It has been assumed that the submerged weir lies between Ogdensburg and Lock 27, near the head of the Galop Rapids, and the mean elevation of the crest of this weir is 230 feet above mean sea level at New York. The discharge equation, as deduced for summer flow, May to November, inclusive, before the Gut channel at the Galop Rapids was closed, is:

$$D_{1\ (\text{SUMMER})\ \text{ST. LAWRENCE}} = \frac{C_{\text{OG.}} + C_{27}}{2} F^{\frac{1}{2}} \left(h_U + \frac{h_D}{2}\right). \qquad (32)$$

in which $C_{\text{OG.}}$, for the upstream head measured at Ogdensburg self-registering gage, is $= \dfrac{114430.485}{\dfrac{152.389}{h_U} + 1}$,

C_{27}, for the downstream head, measured at Lock 27, is $= \dfrac{54597.508}{\dfrac{59.445}{h_D} + 1}$,

F = fall, Ogdensburg to Lock 27,
h_U = upstream head on crest (elevation 230) of submerged weir, determined by Ogdensburg gage height,
h_D = downstream head on crest (elevation 230) of submerged weir, determined by Lock 27 gage height.

68. The slope in the river, from Oswego and Ogdensburg to Lock 27, increases in the winter, due to the ice covering, which causes increased friction with the water and decreases the discharge for a given stage. The average increase in fall for the winter season, between Lock 27 and Ogdensburg, has been determined as 0.31 foot. For any given stage at Lock 27, with mean summer slope to Ogdensburg, the discharge of the St. Lawrence River can be derived by formula (32). With this known river discharge and stage at Lock 27, and with Ogdensburg gage heights increased by 0.31 foot for average winter conditions, a solution for C in the submerged-weir formula has been made. This operation was repeated so as to cover the range in stage at these two gages.

69. The winter discharge equation, as deduced, covering the period from December to April, inclusive, and before the Gut channel at the Galop Rapids was closed, is:

$$D_{1\ (\text{WINTER})\ \text{ST. LAWRENCE}} = \frac{C_{\text{OG.}} + C_{27}}{2} F^{\frac{1}{2}} \left(h_U + \frac{h_D}{2}\right), \qquad (33)$$

in which $C_{\text{OG.}}$, for the upstream head, measured at Ogdensburg self-registering gage in the winter season, is $= \dfrac{131202.913}{\dfrac{206.737}{h_U} + 1}$,

C_{27}, for the downstream head, measured at Lock 27 in the winter season, is $= \dfrac{53597.993}{\dfrac{67.401}{h_D} + 1}$,

F = fall, Ogdensburg to Lock 27,
h_U = upstream head on crest (elevation 230) of submerged weir, determined by Ogdensburg gage heights,

h_D = downstream head on crest (elevation 230) of submerged weir, determined by Lock 27 gage heights.

70. As previously stated, the winter months have been considered as December to April, inclusive. During many of these months, ice gorges have occurred in the river, above the Galop Rapids, which conditions have invalidated the winter-slope relation and caused abnormally high discharge values. Fortunately, below the Galop there are two more submerged weirs, one at the head of Rapide Plat, near Lock 24 on the Morrisburg Canal, and the other at the head of the Long Sault Rapids, near Lock 21 on the Cornwall Canal, at which points water-level observations have been made by the Canadian Government for many years.

71. Owing to lack of data, the Commission has been unable to derive a submerged-weir formula for the St. Lawrence River discharge based on the stage of water at the Rapide Plat and Long Sault Rapids, and has used the overfall-weir formula derived by the United States Lake Survey for these two locations, and has also used in a few instances the overfall-weir formula in terms of Lock 27, when ice gorges occurred at Lock 24 and Lock 21 and the slope in the river above the Galop was abnormal.

72. These discharge equations for the St. Lawrence River flow are:

$$D_{27\ \text{ST. LAWRENCE}} = 5732\ (2.80 + h_{27})^{\frac{3}{2}}, \tag{34}$$

$$D_{24\ \text{ST. LAWRENCE}} = 16.60(22.10 + h_{24})^{2.8}, \tag{35}$$

$$D_{21\ \text{ST. LAWRENCE}} = 316.0(8.30 + h_{21})^{2.3}, \tag{36}$$

where h_{27}, h_{24}, and h_{21} are the gage readings above the old lock sill of each lock as zero.

73. In determining the monthly mean discharge of the St. Lawrence River for January, February, and March, from 1870 to 1907, inclusive, values have been deduced according to the submerged-weir and the three overfall-weir formulæ. The minimum result in each case has been used as the most reliable value.

74. In 1903, the Canadian Government began work on closing the Gut channel, the smallest of the three channels at the head of the Galop Rapids. The damming of this outlet decreased the discharge of the St. Lawrence River for any given stage. According to the United States Lake Survey, this change in flow has been about 5½ per cent. less than that for the assumed original condition, January, 1860, to August, 1903, inclusive. This percentage change has been applied to the discharge equations for the period previous to September, 1903, and other discharge formulæ deduced.

75. The formula as derived for summer conditions of flow of the St. Lawrence, after the Gut channel was closed, is:

$$D_{2\ (\text{SUMMER})\ \text{ST. LAWRENCE}} = \frac{C_{\text{OG.}} + C_{27}}{2} F^{\frac{1}{2}} \left(h_U + \frac{h_D}{2}\right) \tag{37}$$

in which C for the upstream head, measured at Ogdensburg self-registering gage, is: $C_{\text{OG.}} = \dfrac{104112.068}{\dfrac{146.326}{h_U} + 1}$,

C for the downstream head, measured at Lock 27, is: $C_{27} = \dfrac{55685.721}{\dfrac{65.075}{h_D} + 1}$

F = fall from Ogdensburg self-registering gage to Lock 27,
h_U = upstream head on crest (elevation 230) of submerged weir, determined by Ogdensburg gage heights,
h_D = downstream head on crest, determined by Lock 27 gage heights.

76. The St. Lawrence River winter discharge formula, after the Gut channel was closed, as deduced, is:

$$D_{2\ (\text{WINTER})\ \text{ST. LAWRENCE}} = \frac{C_{\text{OG.}} + C_{27}}{2} F^{\frac{1}{2}} \left(h_U + \frac{h_D}{2} \right), \qquad (38)$$

in which C for Ogdensburg self-registering gage is: $C_{\text{OG.}} = \frac{135093.09}{\frac{226.492}{h_U} + 1}$,

C for Lock 27 is: $C_{27} = \frac{52177.516}{\frac{69.799}{h_D} + 1}$.

The remaining factors are the same as for summer flow.

The monthly mean discharge values of the St. Lawrence River, from January, 1860, to December, 1907, inclusive, are given in Table 22.

DISCHARGE INCREMENTS OF THE RIVER OUTLETS OF THE GREAT LAKES SYSTEM.

77. The discharge increment, or rate of change of river flow per unit change in stage, varies in the several river outlets of the Great Lakes. It is not only different for each river but it also changes with the section and the stage. In general, the increment at mean stage increases with each river lower in this series. The Detroit River increment is greater than the St. Clair; likewise, the St. Lawrence River increment is greater than the Niagara. It also increases as each river is descended. On the Niagara River, the increment at Buffalo Lighthouse, Buffalo, for mean stage of Lake Erie, is 23400 cubic feet per second per foot, while at Grass Island, near the intake of the Niagara Falls Power Company, at Niagara Falls, N.Y., the increment is about 43000 cubic feet per second per foot. There are exceptions to this rule when the river section is contracted. At the head of the Whirlpool Rapids, in the Niagara River, a contracted section reduces the increment to about 9000 cubic feet per second per foot. In the St. Lawrence River, contracted sections occur at the head of the Rapide Plat and the head of the Long Sault Rapids. At the former, the increment is about 22500 cubic feet per second per foot, while at Lake Ontario it is 28100 cubic feet per second per foot. Table 23 gives the discharge increments, expressed in cubic feet per second per foot change in stage, of the several river outlets of the Great Lakes.

TABLE 23.

INCREMENTS OF DISCHARGE OF THE SEVERAL RIVER OUTLETS OF THE GREAT LAKES, EXPRESSED IN CUBIC FEET PER SECOND PER FOOT CHANGE IN STAGE.

RIVER.	LOCATION OF GAGE	STAGE.	INCREMENT.
St. Marys	Sault Ste. Marie, Mich	601.91 (Mean)	18,500
		601—602	18,500
		602—603	18,500
St. Clair	Harbor Beach, Mich	581.44 (Mean)	18,900
		579—580	16,300
		580—581	17,500
		581—582	19,100
		582—583	20,900
Detroit	Windmill Point, Mich	575.40 (Mean)	20,600
		574—575	18,300
		575—576	20,900
		576—577	22,500
Niagara	Buffalo, N.Y	572.67 (Mean)	23,400
		570—571	19,600
		571—572	21,400
		572—573	23,200
		573—574	25,100
St. Lawrence	Ogdensburg, N.Y	245.28 (Mean)	28,100
		244—245	26,800
		245—246	27,600
		246—247	29,300
		247—248	29,800

SUPPLY FACTORS OF GREAT LAKES.

78. The total supply (S) of water to a reservoir or lake depends on the inflow (I) or transmitted supply from another watershed, the precipitation (P) on the surface of the lake, the run-off (R) from the lake's watershed, and evaporation (E) from the lake's surface; or the outflow or discharge (D) from and storage (s) in the lake. Of these factors, for the Great Lakes, the transmitted supply (I), the discharge (D), and the storage (s) are known singly, while the value of precipitation (P), run-off (R), and evaporation (E), is known collectively.

79. The following equation expresses the total supply to any lake:

$$S = I + R + P - E = D \pm s. \tag{39}$$

Now, $s = Ah$, where A is the area of the lake and h the depth in feet above any datum. Transposing and substituting in (39) the value of s, we have:

$$S - D = Ah \tag{40}$$

80. The following equation shows the rate of change in the depth (dh) at any instant of time (dt):

$$(S - D)\, dt = A\, dh \tag{41}$$

Integrating with respect to t and h between the limits o and t and o and h, respectively, we have:

$$(S - D) \int_o^t dt = A \int_o^h dh \tag{42}$$

$$(S - D)\, t = Ah \tag{43}$$

81. An inspection of equation (43) shows that when S is greater than D the lake surface is rising and the storage is increasing, when S is less than D the lake surface is falling and the storage is decreasing; and when S is equal to D the lake surface remains at the same level and there is no change in the storage.

82. The local supply (L) to a reservoir or lake has been assumed as the water-yield from its own watershed. It is also, in s series of connecting watersheds,—equal to the total supply (S) minus the transmitted supply or inflow (I) from the watersheds situated above.

83. The following equation expresses the local supply to any lake:

$$L = S - I = (D + s) - I = R + P - E \tag{44}$$

84. The known supply factors have been deduced for Lakes Superior, Michigan-Huron, Erie, and Ontario for the period of 48 years, from 1860 to 1907, inclusive. These results are shown in Tables 24, 25, 26 and 27, and Plates 2-17, inclusive.

85. For Lake Superior, the water levels at Marquette, Mich., have been assumed to represent the mean lake surface, and those at Sault Ste. Marie, Mich., (above the locks) have been used in computing the discharge of the lake's outlet. The stage readings on the first of the month for this lake and those lower in the series have been interpolated from the monthly mean readings. For Lake Michigan-Huron, the mean of the stage values for Milwaukee, Wis., and Harbor Beach, Mich., has been used for the mean lake surface. Lake St. Clair has been treated as a part of the Michigan-Huron watershed, and the Detroit River, as the natural lake outlet. Since 1900, water has been diverted from Lake Michigan through the Chicago Drainage Canal. The St. Clair River is the outlet to Lake Michigan-Huron, but, owing to the apparent changes in regimen prior to the first accurate discharge measurements in 1899, it became necessary to eliminate this river and use the Detroit, regardless of the fact that there have been many more discharge measurements of the St. Clair. The regimen of the Detroit River has, apparently, remained nearly constant during the period from 1860 to 1907,

inclusive. For Lake Erie, the water levels at Cleveland, Ohio, have been used to represent the mean lake surface, and those at Buffalo, N.Y., to govern the outflow through the Niagara River. The volume of water diverted from the natural outlet of Lake Erie through the Erie and Welland canals has been estimated at 1000 and 1100 cubic feet per second, respectively. These amounts, added to the Niagara River discharge values represent the total outflow from Lake Erie. For Lake Ontario, the Oswego, N.Y., stage readings have been assumed to represent the mean water level of the lake. During periods in the spring, when the Oswego River was at flood stage, these water levels may be slightly in error. The outflow through the St. Lawrence River has been derived from the values of the Ogdensburg and Lock 27 gage heights, used collectively, except as heretofore noted.

86. Lake Superior Supply Factors.—An inspection of Plates 2-5, inclusive, shows that Lake Superior had a maximum monthly mean stage of 604.08, in September, 1869, and a minimum of 600.76, in February, 1871. During the high water of 1876, Superior rose, in August, to 603.93. On several occasions, the lake level has fallen to about 601.0, or lower, as in 1879, 1880, 1892 and 1893. Since 1894, Superior has fluctuated between 601.46 and 603.54, a range of 2.08 feet, while the maximum fluctuation since 1860 has been 3.32 feet. The mean water level for the 48 years, 1860 to 1907, inclusive, was 602.32. The storage capacity of Superior is enormous, one foot depth on the lake surface being equivalent in volume to a constant inflow of 340100 cubic feet per second for one month. During the period which this investigation covers, the storage has been over+200000 cubic feet per second, for a month, on several occasions. In May, 1876, May, 1888, and May, 1899, Superior stored +207500, +212600, and +204100 cubic feet per second, respectively. In August, 1869, the lake stage increased 0.655 foot, equivalent to +222800 cubic feet per second storage. The occurrence of the maximum storage in the month of August is most unusual. At other times, the lake surface has fallen almost as rapidly. In November, 1869, November, 1870, December, 1870, December, 1871, and December, 1897, the storage was −168400, −188800, −173400, −161600, and −137700 cubic feet per second, respectively. The corresponding feet depths on lake surface are: −0.495, −0.555, −0.510, −0.475, and −0.405. For the three months of November, and December, 1870, and January, 1871, Lake Superior fell from 602.47, on November 1st, to 601.06, on February 1st, a storage of −1.41 feet. The outflow from Lake Superior through the St. Marys River has not shown the fluctuations so noticeable in the storage. In September, 1869, the river discharged 128700 cubic feet per second, and in September, 1876, 121800 cubic feet per second. These two values represent the maximum monthly mean discharge to date. On only two occasions has the monthly mean discharge fallen below 50000 cubic feet per second, and that occurred during February and March, 1893, when it reached 48200 and 48400 cubic feet per second, respectively. The total monthly mean supply or water-yield to Lake Superior has ranged between 333300 cubic feet per second, in August, 1869, and −106600, in December, 1870, equivalent to 0.980 and −0.313 foot depth on lake surface, respectively. A maximum monthly mean supply of +200000 cubic feet per second, or more, has occurred in 21 of the 48 years. A minus monthly mean supply has occurred in 42 of the 48 years. Minus values have occurred in each month between October and April, inclusive, although December has been the prevailing one.

87. Lake Michigan-Huron Supply Factors. As shown on Plates 6-9, inclusive, the monthly mean stage of Lake Michigan-Huron has fluctuated between 583.58 and 583.60, in July, 1876, and June, 1886, respectively, and 579.00, in December, 1895, a range of 4.6 feet. Previous to 1886, the lake level had fallen

to about 580.2, or 1.2 feet above the low water of 1895 and 1896, on only three occasions, March, 1869, March, 1872, and January and February, 1873. Since September, 1890, the monthly mean stage has not exceeded 581.5, except in July and August, 1905, and July, 1907, when it was 581.56, 581.54, and 581.56, respectively. The mean stage of Lake Michigan-Huron for the 48 years, 1860 to 1907, inclusive, was 581.38. As previously stated, in Table 1, the area of Lake Michigan-Huron is 45314 square miles. An increase in depth of one foot on this surface is equivalent to a constant inflow of 480700 cubic feet per second for one month. The storage on this lake, in May, 1873, and May, 1876, amounted to +251400 and +254800 cubic feet per second, respectively, with corresponding depths on surface of 0.523 and 0.530 foot. A monthly storage of +150000 cubic feet per second is quite common. Occasionally, the high rate of storage extends over several months, as in April, May, and June, 1876, when the average monthly increase for this period had a value of +220300, equivalent to a total change in stage of +1.37 feet in three months. On the other hand, when the lake stage had fallen, as in August, September, October, November, and December, 1871, the average monthly decrease in storage had a value of −183600 cubic feet per second, equivalent to a total decrease in stage of 1.91 feet in the five months. The minimum storage occurred in September, 1871, when it had a value of −261500 cubic feet per second, equivalent to a depth on lake of −0.544 foot. Values of −150000 to −200000 cubic feet per second have occurred frequently. The outflow through the Detroit River has ranged from about 275400, in July, 1883, to 105300, in February, 1874. The discharge of this river is dependent not only upon the stage of Lake St. Clair but also upon the fall to Lake Erie. The stage of Lake St. Clair is, in turn, dependent on the discharge from Michigan-Huron and on its outflow to Erie. A large discharge from Michigan-Huron raises Lake St. Clair quickly, while a high stage of Erie decreases the discharge of the Detroit River and raises Lake St. Clair by backwater. An increasing stage of Lake St. Clair with constant fall to Erie, or an increasing fall with the same St. Clair stage, gives increased discharge through the Detroit River.

88. Lakes Michigan-Huron and Erie do not rise and fall simultaneously. In some cases, the former will be rising and the latter falling. This is usually what occurs during the winter months of January, February, and March, and sometimes in December, April, and May. Ice gorges in the St. Clair or Detroit River hold back the water, thus depleting the supply to Erie and storing it in Michigan-Huron. When the gorge occurs in the St. Clair River, Lake St. Clair falls and the slope to Lake Erie becomes less than normal and that to Michigan-Huron greater. When the gorge occurs in the Detroit River, Lake St. Clair rises and the slope to Michigan-Huron is less than normal and that to Erie greater. If ice gorges of the same intensity should occur in the St. Clair and the Detroit rivers, simultaneously, Lake St. Clair would probably not indicate the gorged condition, since the discharge increments of the two rivers would be decreased and the lake would remain at its normal level. By an inspection of the hydrograph of the Great Lakes, as shown on Plate 1, the effect of ice gorges in the St. Clair and Detroit rivers is seen. Attention is called particularly to the following months as indicating large gorges in the St. Clair River: February, 1865; March, 1877; January, 1884 ; February, 1886; April, 1901, and February, 1902. In each case, the stage of Lake St. Clair dropped and Michigan-Huron rose. Large ice gorges in the Detroit River occurred in January, 1870, December, 1876, December, 1880, January, 1889, and February, 1895. This fact is substantiated by the extreme rise in Lake St. Clair and by the fall in Lake Erie. The total monthly mean supply to Lake Michigan-Huron has fluctuated between +470800 cubic feet per second, in June, 1883, and −32000 cubic feet per second, in September, 1871, equivalent to a depth on the lake of +0.979 and −0.067 foot, respectively. In May, 1873, and May and June, 1876, the total supply exceeded

+450000 cubic feet per second. In 10 of the 48 years, the monthly supply has been over +400000 cubic feet per second. Monthly values of +350000 cubic feet per second have occurred in over 60 per cent of the years. Other months show a total supply of less than +25000 cubic feet per second in many of these years. In April and May, 1873, May, 1876, and June, 1883, the local supply to Michigan-Huron was +373000, +365100, +356400, and +389100 cubic feet per second, respectively, corresponding to depth on lake of 0.776, 0.759, 0.741, and 0.809 foot, respectively. In September, 1871, the lake lost by evaporation 125700 cubic feet per second more than the actual precipitation on the lake surface and run-off of the tributary watershed. During the months from August to December, inclusive, a minus local supply has been common, in some cases extending over several months. From August to December, 1894, inclusive, evaporation on the lake surface exceeded the precipitation on the lake surface and run-off from the tributary watershed, and the stage of Lake Michigan-Huron dropped 1.3 feet.

89. Lake Erie Supply Factors. The monthly mean stage of Lake Erie (see Plates 10-13 inclusive), during the period covered in this report, has risen to 574.52, in June, 1876. The minimum stage occurred in February, 1902, when Erie fell to 570.63. During the latter month, an extensive ice gorge occurred in the St. Clair River, which explains the extreme low stage of Erie at that time. Prior to that time, the minimum stage of Erie occurred in November, 1895, when it fell to 570.70. The monthly mean level has fluctuated through an extreme range of 3.89 feet, while the annual mean oscillation in lake level has been 2.53 feet. The mean stage of Erie, from 1860 to 1907, inclusive, was 572.60. The amount of storage, for a rise of one foot in the level of Lake Erie, is equivalent to a flow of 105700 cubic feet per second for one month. On but one occasion has the storage exceeded +100000 cubic feet per second. In April, 1873, it had a value of +103600, equivalent to a depth on lake surface of 0.98 foot. During the month of January, 1865, the storage reached a minimum of −52900 cubic feet per second, corresponding to −0.50 foot on lake surface. A value nearly as small as the latter occurred in November, 1903, when the storage had a value of −49700, equivalent to −0.47 foot. The maximum monthly mean discharge from Lake Erie, 257800 cubic feet per second, equivalent to a depth of 2.44 feet on Lake Erie, occurred in June, 1876. The minimum, 168700 cubic feet per second, equivalent to a depth of 1.60 feet on lake surface, occurred in March, 1896. Ice gorges in the Niagara River, apparently, have had comparatively little effect on the outflow from Lake Erie. The maximum total supply of +314700 cubic feet per second to Erie, corresponding to a depth of +2.98 feet on lake, occurred in April, 1861. Large positive total supply values occurred in April, 1862, April, 1873, March and April, 1876, and June, 1883. The values for the several months are : +307400, +309700, +295600, +289000, and +290300 cubic feet per second, respectively. In 16 out of the 48 years, a total monthly mean supply of +275000 cubic feet per second has been exceeded. During the five-month period from February to June, 1876, inclusive, Erie had a monthly mean total supply greater than +250000 cubic feet per second, and the stage increased 1.82 feet. At other times, the total supply has decreased to less than half the maximum. The minimum, +146900 cubic feet per second, occurred in October, 1891, and November, 1903. The supply was nearly as low in January, 1865, and October, 1895, with values of +149300 and +148500 cubic feet per second, respectively. The local supply to Erie, apparently, has been very much less than to the lakes above. In April, 1873, January and February, 1874, and May, 1892, it exceeded +100000 cubic feet per second by 10600, 3200, 21600, and 9200, respectively. Minus values occur very frequently. In many years, the last six months give a minus local supply. From June, 1884, to March, 1885, inclusive, a minus local supply occurred during the entire period

with an average monthly value of −40400. During this period, the lake fell from 574.14, in June, to 571.92, in March, a change in stage of 2.22 feet, the minimum monthly local supply to Erie of −63600 cubic feet per second, corresponding to a depth on lake surface of −0.60 foot, occurred in December, 1871. From August to November, 1867, inclusive, the monthly local supply was −57700, −60500, −61700, and −56500 cubic feet per second, respectively. Collectively, these values are equivalent to a depth on Lake Erie of 2.23 feet. During September, October and November, 1874, large successive local supply values of −50600, −56100, and −51200 cubic feet per second, respectively, occurred, equivalent to a total depth on Lake Erie of 1.49 feet. For September, October, and November, 1884, the monthly local supply was −53100, −57500, and −50600 cubic feet per second, respectively. These values are, collectively, equivalent to 1.52 feet depth on Lake Erie.

90. Lake Ontario Supply Factors. Referring to Plates 14-17, inclusive, the maximum stage of Lake Ontario occurred in May, 1870, when the lake level had a value of 248.95. In 1861, 1862, 1863, 1864, 1867, 1876, 1883, 1884, 1886, 1887 and 1890, the stage exceeded 248.00. In November, 1895, the lake level dropped to 243.41, which has been the minimum stage during the 48 years from 1860 to 1907, inclusive. In two other years, the stage has fallen below 244.00. This condition occurred in January, November, and December, 1896, and January, and February, 1897. This monthly fluctuation of Ontario is greater than that in any of the other Great Lakes. The maximum range in stage is 5.54 feet. Ontario fell from 248.48, in June, 1867, to 244.51, in January, 1868, a change in level of 3.97 feet. The mean stage of Lake Ontario, for the period from 1860 to 1907, inclusive, was 246.19. A foot depth on Lake Ontario is equivalent to a monthly flow of 76800 cubic feet per second. During March and April, 1873, and March, 1904, the monthly storage equalled or exceeded one foot depth on the lake surface, with corresponding storage values of +79900, +96000, and +76800 cubic feet per second, respectively. Twelve of the 48 years had a monthly storage of +50000 cubic feet per second, or more. During October and November, 1867, the minus storage exceeded −50000 cubic feet per second, the values being −53800, and −57600 cubic feet per second, respectively. The discharge of the St. Lawrence River shows an extreme variation of about 130 per cent. This change in flow is small compared with rivers not having immense storage reservoirs at their sources. The maximum flow has been computed at 351200 and 350500 cubic feet per second, and occurred in May, 1862, and May, 1870, respectively. These values may be slightly too great on account of floods in the Oswego River causing abnormal gage readings for lake stage. These maximum discharge values have been approached in June and July, 1870, when there was little likelihood of the stage being affected by these local floods. In these two months, the flow has been computed at 344100 and 343200 cubic feet per second, respectively. The minimum flow has approximated 155000 cubic feet per second. In February, 1875, March, 1900, and February, 1902, the discharge was 157900, 156600, and 152200 cubic feet per second, respectively. These extreme low discharges have been caused by ice gorges in the river. The minimum outflow, not caused by ice gorges, occurred in December, 1895, and December, 1896, when the discharge was 162500 and 164800 cubic feet per second, respectively. The total supply to Ontario has fluctuated between the maximum of +382400 cubic feet per second, in April, 1870, and the minimum of +154100 cubic feet per second in February, 1875, a range of 228,300 cubic feet per second. The equivalent depths on lake surface are 4.98 and 2.01 feet, respectively. In May, 1861, and April, 1862, the total supply was +377400 and +375600 cubic feet per second, respectively. Values of 325000 cubic feet per second have occurred in 17 of the 48 years. Since May, 1893, the total monthly supply has exceeded +300000 cubic feet per second in but two years,

1903 and 1904. In 10 of the 48 years, the yield, or total supply, varied between +155000 and +175000 cubic feet per second during some months of the winter season. The Ontario local supply had a maximum of +151800 cubic feet per second, in April, 1870. In January, 1881, the minimum value of −34300 cubic feet per second occurred. In 7 years, the monthly mean local supply exceeded +125000 cubic feet per second. In 17 of the 48 years, it exceeded +100000 cubic feet per second. Minus values occurred frequently. The prevailing months for such values have been November, December, January, and February, although a minus local supply has occurred during all the months from August to February, inclusive.

MEAN MONTHLY SUPPLY FACTORS OF GREAT LAKES.

91. The mean monthly supply factors covering the period from 1860 to 1907, inclusive, have been derived from the monthly mean supply values of the several lakes for the 48-year period. Table 28 and Plate 18 give the results in numerical and graphical form. These curves show the mean monthly condition on Lakes Superior, Michigan-Huron, Erie, and Ontario. From Plate 18, Table 29, has been compiled, which shows the approximate date of maximum and minimum mean monthly values of stage, storage, outflow, total supply, and local supply of Lakes Superior, Michigan-Huron, Erie, and Ontario.

TABLE 29.

DATE OF MAXIMUM AND MINIMUM VALUES OF MEAN MONTHLY SUPPLY FACTORS OF THE GREAT LAKES.

LAKE.	STAGE.	STORAGE.	OUTFLOW.	TOTAL SUPPLY.	LOCAL SUPPLY.
Superior, maximum	Sept. 20	May 20	Sept. 1	May 25	May 25
Superior, minimum	Mar. 20	Dec. 10	Mar. 15	Dec. 15	Dec. 15
Michigan-Huron, maximum	July 20	May 5	Aug. 1	May 10	May 5
Michigan-Huron, minimum	Feb. 1	Nov. 1	Feb. 20	Nov. 10	Oct. 25
Erie, maximum	June 25	Apr. 5	July 5	Apr. 20	Apr. 5
Erie, minimum	Feb. 10	Oct. 1	Feb. 20	Oct. 10	Oct. 1
Ontario, maximum	July 1	Apr. 5	July 1	May 5	Apr. 25
Ontario, minimum	Dec. 10	Sept. 5	Feb. 10	Jan. 20	Sept. 25

92. The mean monthly stage cycle on Lake Superior has fluctuated between 602.79, in September, and 601.77, in March, a change of 1.02 feet. A plus storage has occurred during the months of April to September, inclusive, while a minus storage has occurred during the months of October to March, inclusive. The maximum mean monthly storage has been 95900 cubic feet per second, while the minimum has been −91100. The discharge, or outflow, has increased from March 15th, to September 1st, while it has decreased from September 1st, to March 15th. The mean monthly outflow has ranged between 92800 and 68000 cubic feet per second. The total supply has increased values from December to May, and has decreased values from May to December. The mean monthly total supply has had a maximum value of 175700 cubic feet per second, and a minimum value of −10700 cubic feet per second. This minus value, which occurs in December, shows conclusively that the evaporation from Superior may be greater than the precipitation on lake surface and run-off from its watershed. The mean monthly supply, to Superior, in January, has been only 2300 cubic feet per second, which proves that evaporation on lake surface is nearly equal to the precipitation on lake surface and run-off from the tributary watershed for that month.

93. The mean monthly stage of Lake Michigan-Huron has fluctuated between 581.90, in July, and 580.93, in January and February, a range of 0.98 foot. The storage on Michigan-Huron has been positive from February to July,

inclusive, while it has been negative from August to January, inclusive. The maximum and minimum mean monthly storage values have been +132300 and −112200 cubic feet per second, respectively. The mean monthly outflow through the Detroit River has fluctuated from 219700, in August, to 175600 cubic feet per second, in February. This minimum discharge value is probably too large. The mean monthly total supply has had a maximum value of +337700 cubic feet per second in May, and a minimum value of +96200, in November. The mean monthly local supply to Michigan-Huron has fluctuated between +257800 cubic feet per second, in May, and +8200 cubic feet per second, in October. During October and November, the local supply has been so small that the evaporation from the lake surface has been about equal to the precipitation on lake surface and run-off from the tributary watershed.

94. The mean monthly stage on Lake Erie has ranged from 573.24, in June, to 572.03, in February, a fluctuation of 1.21 feet. The storage on Erie has had a positive value from February to June, inclusive, and a negative value from July to January, inclusive. The mean monthly storage has had a maximum value of +44100 cubic feet per second, in April, and a minimum value of −31100 cubic feet per second, in September. The outflow has fluctuated between 225700 cubic feet per second, in July, and 198100 cubic feet per second in February. The mean monthly total supply has had a maximum value of +255700 cubic feet per second, in April, while it has fallen to a minimum value of +179200 cubic feet per second, in October. The mean monthly local supply on Erie has had a positive value from January to June, inclusive, and a negative value from July to December, inclusive. During these last six months, July to December, inclusive, the evaporation on the surface of Lake Erie has been greater than the precipitation on the lake surface and run-off from the tributary watershed. The maximum mean monthly supply local of +56100 cubic feet per second occurred in April, while the minimum of −31800 cubic feet per second occurred in October.

95. The mean monthly stage of Lake Ontario has ranged from 246.95, in June, to 245.57, in December, a fluctuation of 1.38 feet. The storage has shown a positive value from January to June, inclusive, and a negative value from July to December, inclusive. The mean monthly storage has had a maximum value of +34800 cubic feet per second, in April, and a minimum value of −28700 cubic feet per second, in September. The mean monthly outflow through the St. Lawrence River has fluctuated between 283600 cubic feet per second, in July, and 219300 cubic feet per second, in February. The mean monthly total supply has had a maximum value of +297500 cubic feet per second, in May, and a minimum value of +225500 cubic feet per second, in January. The mean monthly local supply to Ontario has ranged from +83800 cubic feet per second, in April, to +18000 cubic feet per second, in September.

96. The maximum mean monthly stage of each lake of the Great Lakes has occurred at different times in the different lakes. This has been equally true with respect to the minimum stage. The maximum discharge of any lake does not occur at the time of the maximum total supply. The minimum discharge of any lake does not occur at the time of the minimum total supply. The maximum local supply of any lake does not occur at the same time as the maximum total supply ; neither does the minimum local supply of any lake occur at the same time as the minimum total supply.

97. Table 30 shows the ratios, $R_{MAX.}$, between the maximum value of mean monthly discharge and the maximum value of mean monthly total supply for each lake in the system ; the time interval in days, $T_{MAX.}$, which elapsed between the date of the occurrence of the maximum value of mean monthly total supply to any lake and that of the maximum value of mean monthly dis-

charge from that lake ; and the time interval, in days, $T_{MIN.}$, which elapsed between the date of the occurrence of the minimum value of mean monthly total supply to any lake and that of the minimum value of mean monthly discharge from that lake.

TABLE 30.

RATIOS—$R_{MAX.}$, $T_{MAX.}$, and $T_{MIN.}$

LAKE.	$R_{MAX.}$	$T_{MAX.}$	$T_{MIN.}$
Superior	0.524	98 days	91 days
Michigan-Huron	0.647	82 days	101 days
Erie	0.884	76 days	132 days
Ontario	0.955	56 days	20 days

98. The ratio, $R_{MAX.}$, increases with each succeeding lake in the Great Lakes system. The maximum mean monthly outflow from Superior has been about 52 per cent. of the maximum mean monthly total supply of that lake, while the maximum mean monthly outflow from Ontario has been about 96 per cent. of the maximum mean monthly total supply to that lake.

99. In order that a comparison of the several supply factors of the several lakes can be intelligently made, part of the data given in Table 28 has been expressed in cubic feet per second per square mile of watershed. Table 31 gives the mean monthly values of storage, outflow, and total supply of Lakes Superior, Michigan-Huron, Erie, and Ontario in terms of the total watershed area, including lake surface, above the lake's outlet, and of local supply of the same lakes in terms of the tributary local watershed area including lake surface. An inspection of this table shows that the mean monthly outflow from these several lakes of the Great Lakes system has been remarkably uniform. The maximun value for Superior has been 1.22 cubic feet per second per square mile, while the minimum value has been 0.89 cubic foot per second per square mile. The maximum value for Michigan-Huron has been 1.00 cubic foot per second per square mile, while the minimum value has been 0.80 cubic foot per second per square mile. The maximum value for Erie has been 0.89 cubic foot per second per square mile, while the minimum value has been 0.78 cubic foot per second per square mile. The maximum value for Ontario has been 0.99 cubic foot per second per square mile, while the minimum value has been 0.76 cubic foot per second per square mile.

100. The mean monthly total supply to Superior has fluctuated between 2.31 cubic feet per second per square mile and −0.14 cubic foot per second per square mile. That to Michigan-Huron has fluctuated between 1.53 cubic feet per second per square mile and 0.44 cubic foot per second per square mile. That to Erie has fluctuated between 1.00 cubic foot per second per square mile and 0.70 cubic foot per second per square mile. That to Ontario has fluctuated between 1.03 cubic feet per second per square mile and 0.78 cubic foot per second per square mile.

101. The mean monthly local supply to Superior has fluctuated between 2.31 cubic feet per second per square mile and −0.14 cubic foot per second per square mile. That to Michigan-Huron has fluctuated between 1.79 cubic feet per second per square mile and 0.06 cubic foot per second per square mile. That to Erie has fluctuated between +1.62 cubic feet per second per square mile and −0.92 cubic foot per second per square mile. That to Ontario has fluctuated between +1.62 cubic feet per second per square mile and 0.55 cubic foot per second per square mile. The average local supply to Erie is considerably less

than that to the other lakes. This is explained in part by the southerly position of the lake in the chain, the general direction of its principal axis coinciding with the direction of the prevailing winds, its shallow depth, and errors in winter discharge values of Detroit River,—all of which tend to decrease the local supply factor.

102. A comparison of the total supply values with the outflow or discharge values, expressed in cubic feet per second per square mile, shows the regulating effect of reservoirs on stream flow. Without reservoirs, the run-off from the lake's watershed is discharged immediately, while, with reservoirs, the run-off is stored and discharged at an approximate uniform rate.

THE REGULATION OF LAKE ERIE AS PROPOSED BY THE UNITED STATES BOARD OF ENGINEERS ON DEEP WATERWAYS.

103. The United States Board of Engineers on Deep Waterways, in 1900, reported on the regulation of Lake Erie, in appendix 6 of their report. The scheme, as proposed by them, consisted of a submerged weir, with regulating sluices, at the outlet of Lake Erie near the angle in the Bird Island Pier, by which the level of the lake might be held at or near some fixed stage. The report says :

"The regulation of the level of the lake implies the maintenance of its surface at or near some fixed stage, to accomplish which the discharge must be so controlled that it will be at all times approximately equal to the difference between the supply of water to the lake and evaporation from the lake surface."

And further, in relation particularly to Lake Erie, the report states :

"To regulate the level of Lake Erie so as to maintain its surface near some fixed place of reference will require such control of the outflow through Niagara River that the storage which would naturally occur in the lake will be discharged during the first half of the year and the outflow will be diminished a like amount during the last half of the year. This modification of outflow will not materially change the total volume of discharge for any entire year and will amount to only one-fifth of the variation of discharge of the river for different years under present conditions. The effect of this modification of flow through Niagara River, on the level of Lake Ontario, will be to slightly increase the rate of rise in the spring and make the date of maximum stage a little earlier."

104. The scheme of regulation, as proposed by the Board of Engineers on Deep Waterways, is to not allow the monthly mean stage of Lake Erie, at Buffalo, to rise above 574.5 feet, old levels, or 574.7 feet, 1903 levels, above mean tide at New York. The minimum monthly stage of lake surface, under regulation, is not definitely stated, but it is intimated to be about 573.7 feet, 1903 levels, in the following paragraphs taken from their report :

(1) "The three months in which the supply was materially in excess of the discharge for proposed regulated stage were February, March, and April, during which the excess averaged 19000 cubic feet per second, corresponding to a rise of 0.2 foot in February, 0.2 foot in March, and 0.15 foot in April. Hence, if the level of the lake, when regulated, should be allowed to fall 0.6 foot every year after the close of navigation, it is probable that the excess of supply over discharge would never cause the surface to rise above the plane of regulation."

(2) "In the fall of 1875, the discharge of Niagara River was 60000 cubic feet per second less than the capacity of the regulating works ; and, if the lake had been regulated, with the sluices of the regulating works all open, the surface would have been lowered one foot in about two months, or sufficient to have stored the excessive supply which occurred in the spring of 1876, with a margin of 0.4 foot for contingencies."

105. According to the discharge equation determined by the Board of Engineers on Deep Waterways, the maximum discharge of Niagara River was 277270 cubic feet per second, with the lake regulated at stage 574.70, 1903 levels, and the minimum discharge was 178000 cubic feet per second at stage 570.70, 1903 levels. The discharge formula of Niagara River, deducted by the International Waterways Commission, is based upon more complete data and gives the maximum discharge as 261500 cubic feet per second at 574.7, 1903 levels, and the minimum as 166700 cubic feet per second at stage 570.7, 1903 levels. In this report, the latter discharge values are used instead of those of the Board of Engineers on Deep Waterways.

PRACTICAL REGULATION OF LAKE ERIE BETWEEN STAGES 573.7 AND 574.7, 1903 LEVELS.

106. In working out a practical scheme for regulation, it is quite necessary to set a definite elevation for the regulated stage of Lake Erie at the beginning of each month. The stage values used in this investigation are given in Table 32.

TABLE 32.

STAGE OF LAKE ERIE DESIRED ON FIRST OF MONTH, WITH REGULATED CONDITIONS.

MONTH.	STAGE DESIRED AT BEGINNING OF EACH MONTH.	MONTH.	STAGE DESIRED AT BEGINNING OF EACH MONTH.
January 1	573.8	August 1	574.0
February 1	573.7	September 1	574.0
March 1	573.7	October 1	574.0
April 1	573.8	November 1	574.0
May 1	573.9	December 1	573.9
June 1	574.0	January 1	573.8
July 1	574.0		

107. The maximum desired stage of water from June 1st to November 1st, inclusive, as shown in the above table, allows 0.7 foot for contingencies, which, as will be seen, is not adequate. The regulation of the elevation of the level of Lake Erie between stages 573.7 and 574.7 is a difficult proposition on account of the variation in total supply. It is impossible to estimate this factor with any degree of accuracy on account of the fluctuation of inflow, precipitation, run-off, and evaporation. This fact is very strongly brought out in the data and results shown in Table 33 and Plate 19, "Regulation of Lake Erie between stages 573.7 and 574.7." The difference between the expected total supply and the actual total supply for any one month has been as great as +47800 cubic feet per second, in April, 1891, and −40200 cubic feet per second, in April, 1892, which would have caused a difference in the expected change in stage of Lake Erie of 0.4 to 0.5 foot. In June, 1892 (see Table 33) the lake level is supposed to have reached 574.0 on the 1st of July, and regulating works are assumed to have been set to give a discharge that would bring the lake to this stage by the first of the following month, but, owing to the increase in the actual total supply over the expected total supply, the lake would have risen to 574.64, which is 0.64 foot more than the desired and estimated stage. This unlooked-for variation in a high-water year, such as 1876, might prove disastrous if the lake level were at or near stage 574.7. By examining Table 33, it is also seen that the regulated level of Lake Erie would have fallen, in most years, during some of the winter months, to 573.3, approximately, or 0.4 foot below the minimum stage set by the Board of Engineers on Deep Waterways, but would have risen above 573.7 by the opening of the season of navigation. With the proposed scheme of regulation, for the period from 1890 to 1906, inclusive, the level of Lake Erie would have risen 0.04 foot above 574.7, in June, 1892.

108. The period from 1890 to 1906, inclusive, does not include an extreme high-water year. If the proposed scheme of regulation had occurred in 1876, when the monthly mean stage of Lake Erie reached 574.5, in June, then the assumed maximum level (574.7) would have been exceeded, during April to July, inclusive, by 0.03, 0.19, 0.20, and 0.05 foot, respectively (see Table 33).

109. During the period from 1890 to 1906, inclusive, with regulation, the mean level of Lake Erie would have been raised from 572.1 to about 573.9, an increase in mean stage of 1.8 feet. During the low-water year of 1895, the mean annual level, with regulation, would have been 2.57 feet higher than the actual

stage. The extreme low monthly mean stage of 570.71, in November, 1895, would have been raised by regulation to 573.59, an increase of 2.88 feet. The actual oscillation in monthly mean water level of Lake Erie has been about 3.89 feet. With regulation as proposed, the range of monthly mean oscillation would have been reduced to 1.43 feet during the year, and to 1.14 feet during the navigation season.

110. Perfect regulation is impossible. The monthly increase in stage of Lake Erie, with natural conditions, is frequently 0.4 to 0.5 foot; occasionally exceeds 0.8 foot; and has been as great as 0.98 foot. Daily oscillations in the stage are occasionally as large as 7 or 8 feet, and hourly variations sometimes exceed 2 feet. Southwesterly storms on the lake raise the water level at Buffalo and lower it at Amherstburg by several feet from the normal. This difference of level has been as large as 15 feet with the severest storms. To control this daily and hourly variation in stage of Lake Erie within small limits is impossible.

EFFECT OF REGULATION OF LAKE ERIE, BETWEEN STAGES 573.7 AND 574.7, ON WATER LEVELS OF LAKE ONTARIO AND ST. LAWRENCE CANALS.

111. The effect of the regulation of the stage of Lake Erie, between 573.7 and 574.7, on the water levels of Lake Ontario, for the period from 1890 to 1906, inclusive, is shown on Plate 20, which illustrates the increased range in stage of Lake Ontario and the detrimental effect to navigation in the St. Lawrence canals due to the proposed regulation of Lake Erie under the scheme proposed by the Board of Engineers on Deep Waterways.

PRACTICAL REGULATION OF LAKE ERIE BETWEEN STAGES 572.0 AND 574.5, 1903 LEVELS.

112. Inasmuch as it is deemed impracticable to regulate the monthly mean stage of Lake Erie between stages 573.7 and 574.7 feet above mean tide at New York, as proposed in the plan of the Board of Engineers on Deep Waterways, the investigation was continued to determine the limits between which the regulation of the monthly mean stage of Lake Erie would be practicable.

113. As in the previous plan of lake regulation, a definite elevation for the stage of the lake on the first of each month has been assumed. These values represent the limits within which it would be necessary to attempt to hold the stage of Lake Erie so that the maximum and miminum monthly mean water levels of 574.5 and 572.0, respectively, would not be exceeded. Table 34 shows the assumed elevations desired on the first of month, of the water surface of Lake Erie, for regulation of its monthly mean stage between 572.0 and 574.5.

TABLE 34.

STAGE OF LAKE ERIE DESIRED ON FIRST OF MONTH WITH LAKE REGULATED BETWEEN 572.0 AND 574.5.

MONTH.	STAGE DESIRED AT BEGINNING OF EACH MONTH.	MONTH.	STAGE DESIRED AT BEGINNING OF EACH MONTH.
January 1	572.3	August 1	572.5
February 1	572.2	September 1	572.5
March 1	572.2	October 1	572.5
April 1	572.2	November 1	572.5
May 1	572.3	December 1	572.4
June 1	572.4	January 1	572.3
July 1	572.5		

114. An inspection of Table 34 shows that 2.0 feet and 0.2 foot have been allowed for the actual fluctuations from the desired maximum and minimum monthly mean stages, respectively, of Lake Erie, with regulation. This extreme allowable fluctuation from the desired maximum is necessitated by the extreme high water of 1876, during which year the surface of Lake Erie, at Buffalo, reached a mean level of 574.49, in June, or but 0.01 foot less than the maximum monthly mean stage allowable with regulation.

115. As 1876 is the controlling high-water year, so 1895 is the controlling low-water year. Computations have been made for these two extreme years instead of for the period from 1890 to 1906, inclusive, as in the investigation of the scheme outlined by the Board of Engineers on Deep Waterways.

116. Table 35 and Plate 21 show that, with regulation, the water levels of Lake Erie, at Buffalo, differ but slightly from the actual levels for the year 1876, while for the low-water year of 1895 the annual mean level would be increased from 571.26 to 572.33, a change of +1.07 feet, and the mean level for the extreme low-water months of November and December (both in the navigation season) would be increased from 570.71 and 570.97 to 572.09 and 572.34, respectively, or a change of +1.38 feet and +1.37 feet, respectively.

EFFECT OF REGULATION OF LAKE ERIE, BETWEEN STAGES 572.0 AND 574.5, ON WATER LEVELS OF LAKE ONTARIO AND ST. LAWRENCE CANALS.

117. Any change in the outflow of Lake Erie will change the water levels of Lake Ontario. If the inflow to Ontario is increased, the lake level will rise, and with decreased inflow the level will fall. Table 36 and Plate 21 show the effect on the water levels of Lake Ontario for the years of 1876 and 1895, if Lake Erie stage had been regulated between stages 572.0 and 574.5 for those years. The effect of the regulation of Lake Erie would have been to increase the fluctuation in stage of Lake Ontario, causing higher stage in spring and lower stage in the autumn than under actual conditions.

118. For the high-water year of 1876, during which time the regulated inflow would have differed but slightly from the actual, there would have been no appreciable increase in the fluctuation in stage on Lake Ontario, and at no time during the year would the regulated stage differ from the actual by more than 0.12 foot. In 1895, however, a low-water year on Lake Ontario as well as on Lake Erie, the fluctuation would have increased with the result that during the months from September to December, inclusive, the regulated stages would have fallen to 243.70, 243.26, 243.08, and 243.33, respectively, or 0.34, 0.38, 0.33, and 0.18 foot, respectively, below the actual stages for those months.

119. During an extended period, such as from 1890 to 1906, inclusive, differences of 0.4 to 0.5 foot between the actual stage of Lake Ontario and the stage that would have prevailed under regulated conditions on Lake Erie would be of frequent occurrence. Unfortunately, these variations, with respect to actual stage, are generally negative during the period of low water and positive during the period of high water. Such conditions, caused by regulating Lake Erie, would injuriously affect navigation in the St. Lawrence canals and would decrease the draft of vessels by 0.4 to 0.5 foot, in the Galop canals, and 0.7 to 0.8 foot, in the Morrisburg canals. Barges and tows that now load to 14 feet draft would be compelled to load not more than 13.2 or 13.3 feet draft during September, October and November, in most years, and in some years during the entire season of navigation.

EFFECT OF REGULATION OF LAKE ERIE, BETWEEN STAGES 572.0 AND 574.5, ON WATER LEVELS OF NIAGARA RIVER.

120. By the proposed system of regulation, the stage of water in the Niagara River would not fluctuate through any greater range than under actual conditions. During the winter months, more frequent low water would probably occur under regulation than under actual conditions, in which case the power companies at Niagara Falls would probably have more difficulty in keeping the channels to their intakes free from ice. During the fall months, navigation in the river might be slightly interfered with owing to the storage in the lake of a part of the natural discharge.

EFFECT OF REGULATION OF LAKE ERIE, BETWEEN STAGES 572.0 AND 574.5, ON WATER LEVELS OF LAKE ST. CLAIR, LAKE MICHIGAN-HURON AND CONNECTING WATERS.

121. By the proposed regulation of Lake Erie between stages 572.0 and 574.5, the mean level of this lake would have been raised about 1 foot. This increase in stage would have decreased the mean slope in the Detroit River and would have caused Lake St. Clair to rise until the discharge through the Detroit River had a value equal to the discharge under natural conditions for the same period. An examination of Tables 8 and 9 shows that the mean stage of Lake St. Clair, at Windmill Point, was 575.40, and that of the lower end of the Detroit River, at Amherstburg, was 572.84. From equation 30, the discharge of the Detroit River is computed to be 204900 cubic feet per second for mean stages of 575.40, at Windmill Point, and 572.84, at Amherstburg. For this river-discharge value and with the stage at Amherstburg increased by 1.0 foot, the amount that mean level of Lake Erie would have been raised by regulation, it is found that the stage of Lake St. Clair, at Windmill Point, would eventually rise 0.61 foot. This value represents the effect on the stage of Lake St. Clair due to the increase of 1.0 foot in mean stage of Lake Erie under regulation.

122. The rise between actual and regulated low-water stage of Lake Erie would be greater than the corresponding rise between actual and regulated high-water stage. The effect of this would be to slightly lessen the discharge of the Detroit River at low stage and to slightly increase it at high stage.

123. As backwater from Lake Erie raises the water level of Lake St. Clair, so backwater from Lake St. Clair raises the water level of Lake Michigan-Huron. For a given flow in the Detroit River, an increase in the stage of Lake Erie causes an increase in the stage of Lake St. Clair ; likewise, for a given flow in the St. Clair River, an increase in the stage of Lake St. Clair causes an increase in the stage of Lake Michigan-Huron. By the method used above, the effect on the water level of Lake Michigan-Huron, caused by 0.61 foot backwater on Lake St. Clair, due to the regulation of Lake Erie, has been computed to be 0.27 foot rise.

124. A study of Plate 21 shows that for a year of excessive, or above-normal supply, such as 1876, the regulation of Lake Erie would not materially improve navigation. In 1895, a year of deficient supply, the mean level during the eight-month season of navigation would have been increased from 571.31 feet, under natural conditions, to 572.41, under regulated conditions, and navigation on Erie would have been improved by an increased stage of 1.1 feet. The regulation of Lake Erie, between stages 572.0 and 574.5, would raise extreme low stage for the navigation season by at least 1 foot, without an appreciable increase in the extreme high stage. This increase in low stage is equivalent to deepening every harbor and channel in Lake Erie by that amount ; in the Detroit River

and Lake St. Clair, by at least 0.61 foot ; and in the St. Clair River and Lake Michigan-Huron by at least 0.27 foot.

REGULATION OF LAKE SUPERIOR.

125. The regulation of the stage of Lake Superior has been suggested as a means (first) for improving navigation on that lake, and (second) to compensate for the diversion of water from Lake Michigan-Huron through the Chicago Drainage Canal.

126. This Commission has already recommended in its report upon the conditions existing at Sault Ste. Marie that "the level of St. Marys River, above the rapids, shall be maintained between the elevations 601.7 and 603.2 above mean tide at New York." The monthly mean stage of St. Marys River, above the rapids, has not risen above 603.2 since 1860, except in September and October, 1869, and July, August, and September, 1876. It has fallen below 601.7 on numerous occasions, generally during the winter months. In 1879 and 1891, the monthly mean stage did not exceed 601.5, while in 1892 it exceeded 601.7 in only one month. The fall in the water level of the St. Marys River above the rapids, below 601.7, for the ice months of January to April, inclusive, does not interfere with navigation on Lake Superior. The monthly mean water level of Lake Superior was below 601.7 about 20 per cent. of the navigation season (May to December, inclusive), from 1860 to 1888, inclusive. For this cycle of years, the regimen of the St. Marys River had not been materially altered by artificial works. With the completion of the International Bridge piers and approaches in 1888, and the shutting off of spans 1 and 2 of this bridge from the rapids by the Chandler-Dunbar Water Power Company, in 1892, these two principal obstructions to the natural outflow from Lake Superior have raised the water level so that it has not fallen below 601.7 more than about 2 per cent. of the navigation season from 1893 to 1907, inclusive. The difference can not be attributed to the variation in the total supply, or water-yield, to Lake Superior ; for, as a matter of fact, the average total supply for the period from 1860 to 1888, inclusive, was about 4400 cubic feet per second greater than for the period from 1893 to 1907, inclusive.

127. The construction of the compensating works at the head of the St. Marys Rapids by the Michigan Lake Superior Power Company, in 1901 and 1902, cut off a flow of about 9900 cubic feet per second. The 8500 cubic feet per second of water used by this company since 1905 nearly neutralizes the effect of these works.

128. The regulation of Lake Superior during the navigation season, between the elevations 601.7 and 603.2, as measured by the level of the St. Marys River above the rapids, has been accomplished under the conditions that did exist, and no further works seem to be necessary until a change in the artificial diversions at Sault Ste. Marie is made.

129. If the monthly mean level of Lake Superior were to be controlled during the navigation season within a smaller fluctuation than 1.5 feet, then the outflow through the St. Marys River would have to be artificially controlled. In order to eliminate the monthly mean fluctuation in large natural reservoirs, such as Lake Superior and the other lakes in this system, it would be necessary to increase the fluctuations of outflow to correspond to the fluctuations of total supply to that reservoir. To accomplish this result on Lake Superior, the monthly mean outflow would have had a maximum value of 333300 cubic feet per second, in August, 1869, and a minimum value of −106600 cubic feet per second, in December, 1870. Such fluctuations in outflow are impossible, since the minimum discharge of any stream is zero. When the total supply is minus, the level of the lake or reservoir will fall even if the outflow is entirely shut off.

130. The question that now presents itself, since perfect regulation of Superior is impossible, is : Can the fluctuations in stage of Lake Superior be materially reduced ; and if so, what would be the effect on the lower lakes. An examination of Table 24 shows that during November and December, 1870, and January, 1871, the total monthly supply to Lake Superior for these three consecutive months was −99500, −106600, and −42900 cubic feet per second, respectively, equivalent, collectively, to a total depth on the lake surface of −0.732 foot. The level of Lake Superior actually fell 1.41 feet during this period, but, even if the outflow through the St. Marys River had been entirely shut off, the lake would still have fallen over eight and three-quarter inches. During May, June and July, in the high-water year of 1876, the total monthly supply to Lake Superior was 303300, 291200, and 205000 cubic feet per second, respectively—a total of 799500 cubic feet per second, equivalent to a depth on lake surface of +2.351 feet. The outflow through the St. Marys River for the corresponding period was 95800, 109200, and 120000 cubic feet per second, respectively, or an average monthly flow of 108300 cubic feet per second. Granting that this enormous supply of water could have been predicted—an impossibility—and that the St. Marys River could have discharged twice the average monthly outflow, or 216600 cubic feet per second, for three months, through artificial works and channels, which would be very costly to construct, Lake Superior would still have risen over 5¼ inches.

131. If the monthly oscillations in stage of Lake Superior could be materially reduced, then the monthly mean flow through the St. Marys River would fluctuate more than it actually does. Under present conditions, the outflow through the St. Marys River is the greatest during August, September, and October, when the stage of Lake Michigan-Huron is falling very rapidly. Under these natural conditions, the water from Lake Superior aids in the attempt of nature to hold the stage of Lake Michigan-Huron at a fixed elevation. If the outflow from Lake Superior in an average year were increased as much as 50 per cent., during August, September, and October, the level of Lake Michigan-Huron would be raised only about 0.1 foot per month for these months, since the discharge through the St. Marys River is not the supply factor that produces the principal effect on the stage of Lake Michigan-Huron.

132. These cases show, first, that the artificial regulation of Lake Superior would not materially decrease the present fluctuation of water level ; second, that Lake Superior is one of the best naturally regulated bodies of water in the world ; and, third, that the effect of the artificial regulation of the level of Lake Superior on the level of Lake Michigan-Huron would produce only insignificant results.

DIVERSION OF WATER THROUGH CHICAGO DRAINAGE CANAL, THE EFFECT OF DIVERSION ON LAKES MICHIGAN-HURON, ERIE, AND ONTARIO, AND THE REGULATION OF LAKE SUPERIOR TO COMPENSATE FOR DIVERSION AT CHICAGO.

133. The Chicago Drainage Canal has diverted water from Lake Michigan-Huron since 1900. This has lowered the level of Lakes Michigan-Huron, St. Clair, Erie, and Ontario, regardless of the fact that these lakes are at higher stages than they were when the canal was opened. These higher stages are due to the increase in the quantity of water supplied since 1900. If this supply had not been increased, then the stages of the lakes would have been actually less. Plates 22, 23, and 24 show the monthly loss of level on Lakes Michigan-Huron, Erie, and Ontario, respectively, under the actual diversion through the Chicago Drainage Canal, and also under assumed diversions of 10000 and 14000 cubic feet per second.

TABLE 37.

LOSS OF LEVEL ON LAKES MICHIGAN-HURON, ERIE, AND ONTARIO UNDER THE ACTUAL DIVERSION AND UNDER ASSUMED DIVERSIONS OF 10000 AND 14000 C.F.S. THROUGH THE CHICAGO DRAINAGE CANAL, 1900-1907, INCLUSIVE.

LAKE.	LOSS OF LEVEL IN INCHES.		
	ACTUAL DIVERSION.	ASSUMED DIVERSION OF	
		10000 c. f. s.	14000 c. f. s.
Michigan-Huron	2-5/8	6-1/2	9-3/8
Erie	2-1/2	5-7/8	8
Ontario	1-7/8	4-1/4	6

134. The stage of Lake Michigan-Huron is 2⅝ inches lower than it would have been if there had not been any water diverted through the Chicago Drainage Canal. Likewise, the stages of Lake Erie and Lake Ontario are 2½ and 1⅞ inches lower, respectively, than they would have been with no diversion at Chicago. If the quantity of water diverted through the canal had been as much as 10000 or 14000 cubic feet per second, then the effect would have been proportionately greater.

135. Since the effect of the diversion is to lower the level of the lakes and connecting channels of the Great Lakes system, with the exception of Lake Superior and the upper St. Marys River, and as this effect will increase with the increase in the quantity of water diverted, therefore, the question presents itself : Can the present diversion or future diversions through the Chicago Drainage Canal be compensated for by the use of Lake Superior as a storage reservoir, so that the level of the lakes below Superior will not be lowered ?

136. The longest low-stage period of outflow from Lake Superior has been selected in order to obtain a solution to the question. An examination of Plates 2 to 5, inclusive, shows that such a period occurred between June, 1888, and August, 1893. The average flow for the low-water year of 1892 was 65700 cubic feet per second. Assuming a continuous discharge from Superior of the average flow for that year, and, in addition, first, 4000 and, second, 14000 cubic feet per second, respectively, to compensate for a diversion of these amounts through the Chicago Drainage Canal, or a total continuous discharge of, first, 69700 cubic feet per second, and, second, 79700 cubic feet per second, respectively, between June 1, 1888, and August 31, 1893, then the regulated stages of all the lakes in the Great Lakes system would have differed materially from the actual stages. Plate 25 and Tables 38, 39, 40, 41, and 42 show these changes in stage of Lakes Superior, Michigan-Huron, Erie, and Ontario, due to regulation of outflow from Lake Superior to compensate for diversions through the Chicago Drainage Canal of 4000 and 14000 cubic feet per second.

137. To compensate for a diversion of 4000 cubic feet per second through the Chicago Drainage Canal, with the continuous discharge of water from Lake Superior of 69700 cubic feet per second between June 1, 1888, and August 31, 1893, the stage of the St. Marys River, as measured at Sault Ste. Marie (above the locks) would have been higher than it was actually. In August, 1893, the level of Superior would have returned to approximately the actual stage. Under assumed conditions, the mean stage of Lake Superior would have been increased during the period from June, 1888, to August, 1893, at the expense of the decrease in stage of Lakes Michigan-Huron, Erie, and Ontario. The cumulative effect of the constant discharge of 69700 cubic feet per second from Lake Superior during this five-year period would have been to lower the monthly mean stage of Lake Michigan-Huron from 579.88 to 579.53, and from 579.82 to 579.48, in November

and December, 1891, respectively. These stages would have been only 0.36 and 0.48 foot higher, respectively, than the actual stages for the corresponding months of November and December in the extreme low-water year of 1895, and would have been 0.23 and 0.28 foot lower, respectively, than the mean stage for the entire navigation season of 1895, when the shipping interests were so seriously affected. This constant discharge of water from Lake Superior would also have lowered the monthly mean stage of Lake Erie from 571.21 to 570.89, and from 571.28 to 570.96, in November and December, 1891, respectively, which would have been only 0.19 and 0.10 foot higher, respectively, than the actual stages in November and December, 1895. The monthly mean stage of Lake Ontario would have been decreased by this discharge from Lake Superior from 244.44 to 244.19, and from 244.41 to 244.16, in November and December, 1891, respectively.

138. At the end of August, 1893, the water stored in Lake Superior would have been delivered to the lower lakes, and no storage water would have been available, in addition to the actual supply, to compensate for the diversion of water through the Chicago Drainage Canal, and prevent the mean levels of Lakes Michigan-Huron, Erie, and Ontario falling below the actual stages.

139. The monthly mean discharge of the St. Marys River was greater than 69700 cubic feet per second in September, October, and November, 1893. This excess would have allowed 6900, 5800, and 4800 cubic feet per second of water, respectively, to have been stored in Lake Superior in these months. The storage of this volume of water would have temporarily taken it away from the supply to Lake Michigan-Huron, and would have lowered the level of that lake temporarily. Later, when this stored water would have been discharged into the lakes below, their stages would have been the same as under natural conditions, and during the interval between the storage and discharge of this water the diversion of water through the Chicago Drainage Canal would have lowered the mean level of Lakes Michigan-Huron, Erie, and Ontario as it has under actual conditions. If the outlet were to have been artificially changed so that the St. Marys River could have discharged 4000 cubic feet per second in addition to the actual discharge, beginning with September, 1893, in order to compensate for an assumed diversion of this amount at Chicago, then it would have been only a few years before Lake Superior would have fallen so low in stage that navigation would have been seriously interfered with.

140. To compensate for a diversion of 14000 cubic feet per second through the Chicago Drainage Canal, with the continuous discharge of water from Lake Superior of 79700 cubic feet per second between June 1, 1888, and August 31, 1893, the stage of the St. Marys River, as measured at Sault Ste. Marie (above the locks) would have been lower by 1.4 feet than it was actually. This increased discharge from Lake Superior would produce the same effect on the lower lakes as the effect of the previous discharge of 69700 cubic feet per second, since the increased outflow from Lake Superior would be taken by the additional diversion through the Chicago Drainage Canal. The stage of the St. Marys River, at Sault Ste. Marie (above the locks) would have fallen, in May, 1893, to slightly below 600.0, which would have seriously interfered with the navigation of Lake Superior by the present lake vessels. At the end of this five-year period, the level of Lake Superior would have been extremely low and water would not have been available for storage in Lake Superior for the next low-water period.

141. The annual mean stage of the St. Marys River, above the locks, fell to 600.96, in 1879. This minimum value must not be taken as a criterion for permissible low water for navigation purposes; neither should it be assumed that the minimum annual mean stage on the remaining lakes, as a permanent level, would be satisfactory to navigation.

142. The artificial storage of water in Lake Superior must be commenced by shutting off the transmitted supply to the lakes below Superior in the Great Lakes system. When the stored water is allowed to flow from Lake Superior, the total supply to Lakes Michigan-Huron, Erie, and Ontario will be the same as under actual conditions, and the mean level of these lakes will remain unchanged.

143. An artificial storage of water in Lake Superior has taken place, beginning with the construction of the International Bridge and its approaches in 1888. The storing of this water in Superior has withheld it temporarily from the lakes below, and, as a result, the stages of the latter have been changed from what they would have been if there had been no artificial changes in the outlet to Lake Superior. Plates 26, 27, 28, and 29 show the monthly mean stages of the Great Lakes under actual conditions and as they would have been if no artificial works had been built in the upper St. Marys River.

144. An inspection of Plate 26 shows that the artificial storage of water in Lake Superior, created by the building in the upper St. Marys River of the International Bridge and approaches in 1888, of cutting off from the rapids the flow through spans 1 and 2 of this bridge from the American shore by the Chandler-Dunbar Water Power Company in 1892, and of building the compensating works immediately above the bridge, on the Canadian side, by the Michigan Lake Superior Power Company in 1901, has raised the monthly mean level of Lake Superior approximately 1 foot (0.966) in August, 1904. Owing to diversions of water at Sault Ste. Marie for power and other purposes, this effect is less by about 0.4 foot than the computed ultimate rise due to these obstructions. Since January, 1905, when the Michigan Lake Superior Power Company began to divert approximately 8500 cubic feet per second of water from the river for power purposes, the difference between the actual and original efflux stages has decreased to approximately 0.6 foot, a loss in level between 1904 and 1907 of 0.4 foot. Under original efflux conditions, the monthly mean level of Lake Superior would have fallen from 601.02 to 600.76, in April, 1892 ; from 601.01 to 600.82, in February, 1893 ; from 601.46 to 600.92, in March, 1898, and from 601.88 to 601.02, in March, 1903. The annual mean stage of Lake Superior, for 1904, would have been 601.84 under original conditions, while it was 602.71 under actual conditions. This artificial storage of water, due to the obstructions at the controlling section of the upper St. Marys River, partly explains why the stage of Lake Superior has been gradually rising while the stages of the lower lakes have not followed the same general upward trend.

145. The storing of water in Lake Superior has had its effect on the stage of the lower lakes. An increase in the transmitted supply from Lake Superior raises the stage of Lake Michigan-Huron an amount equal to the increase divided by the increment of discharge through the St. Clair River. The amount of additional water from Lake Superior that would have flowed into Lake Michigan-Huron between December, 1888, and December, 1904, is equivalent to the decrease in storage on Superior. This quantity represents a slice 0.87 foot thick over the entire surface of Lake Superior, equivalent to an average monthly increase in discharge of 1530 cubic feet per second through the St. Marys River between December, 1888, and December, 1904, inclusive. Under actual conditions, this increase in discharge would not be a constant quantity but would change according to the effect of the obstruction or the diversion. Plate 27 shows a comparison of the monthly mean water levels of Lake Michigan-Huron under actual and original efflux conditions of the St. Marys River. The effect of storing water in Lake Superior by the cutting off of spans 1 and 2 of the International Bridge at Sault Ste. Marie, in 1892, by the Chandler-Dunbar Water Power Company, was to lower Lake Michigan-Huron by about 0.15 foot in 1894

and 1895. In 1896, the Lake Superior Power Company began to use water for power purposes on a large scale, which partially counteracted the effect of the obstructions. In 1902, the effect of the compensating works of the Michigan Lake Superior Power Company was to lower Lake Michigan-Huron by about 0.15 foot. In 1905, the Michigan Lake Superior Power Company began the diversion of water through their canal on the American side, which has, apparently, raised the stage of Lake Michigan-Huron about 0.1 foot, but in so doing it has been done at the expense of lowering Lake Superior by about 0.4 foot.

146. The effect on Lakes Erie and Ontario of the artificial storage of water in Lake Superior is slightly less than the effect on Lake Michigan-Huron. This decrease in effect is due to the increase in the increment of discharge of the outlets of Lakes Erie and Ontario. Plates 28 and 29 show a comparison of the monthly mean water levels of Lake Erie and of Lake Ontario, respectively, under actual and original efflux conditions of St. Marys River. While the effect of the cutting off of the flow through spans 1 and 2 from the rapids of the St. Marys River occurred about December, 1892, it was not materially felt on Lake Michigan-Huron until the latter part of 1893 ; not in Lake Erie until the middle of 1894, and not in Lake Ontario until the end of 1894. The effect of the construction of the compensating works at Sault Ste. Marie by the Michigan Lake Superior Power Company is also noticeable on these lakes. All the other changes in stage on Lake Michigan-Huron are faithfully reproduced on the stage of Lakes Erie and Ontario, the only difference being that they occur a little later and the effect becomes slightly less on each lake lower in the series. Where the maximum effect on Lake Michigan-Huron was about 0.15 foot, it was about 0.12 foot on Lake Erie, and about 0.10 foot on Lake Ontario.

147. The artificial storage of water in Lake Superior between December, 1888, and December, 1907, inclusive, by the placing of obstructions in the upper St. Marys River, has had the effect of raising the mean stage of Lake Superior by about 0.87 foot in 1904, and of lowering Lake Michigan-Huron, Lake Erie, and Lake Ontario by a maximum of 0.15, 0.12, and 0.10 foot, respectively. This hydraulic experiment, which has been carried on since 1888, shows that the use of Lake Superior as a storage reservoir can not be successful if navigation is to be maintained unimpaired on Lake Superior and the St. Marys River.

REGULATION OF LAKE MICHIGAN–HURON.

148. To regulate the level of Lake-Michigan Huron near some fixed plane of reference would require regulating works at or near the head of the St. Clair River. The storage in the lake, that occurs in the first part of the year, could then be discharged through these works, while the outflow from the lake during the last half of the year could be diminished by an amount equal to the negative storage. An examination of Table 28 and Plate 18 shows that the monthly mean total supply to Lake Michigan-Huron for an average year has been as great as 337700 cubic feet per second, in May, and as small as 96200 cubic feet per second, in November. Plates 7 and 6 show that the maximum and minimum monthly mean total supply has been 470800 cubic feet per second, in June, 1883, and −32000 cubic feet per second, in September, 1871, respectively. The maximum monthly mean discharge from this lake, which occurred in July, 1883, has been determined as 275400 cubic feet per second. On the basis of the above extremes for total supply, to accomplish perfect regulation of this lake would necessitate provision for a maximum outflow of 470800 cubic feet per second, and a minimum of −32000 cubic feet per second. This required maximum outflow is 195400 cubic feet per second, or 71 per cent. greater than the actual maximum. If the outflow from Lake Michigan-Huron had been entirely shut off in September, 1871, the lake would still have fallen about 0.07 foot during that

month. For the period of five months, August to December, 1871, inclusive, the average outflow from Lake Michigan-Huron, with perfect regulation, would have been only 43500 cubic feet per second ; likewise, for the period of five months, August to December, 1894, inclusive, and for the months of September, October, and November, in the low-water year of 1895, the average outflow with perfect regulation would have been only 71700 and 46600 cubic feet per second, respectively. On account of the small quantity of water that would have flowed in the St. Clair and Detroit rivers during these three periods, the stage of these rivers, of Lake St. Clair, and of Lake Erie would have been lowered several feet below the lowest known monthly water levels, and present navigation on the Great Lakes, below Lake Michigan-Huron, would have been entirely suspended.

149. These examples that have been cited show that the perfect regulation of Lake Michigan-Huron at a fixed plane of reference is not feasible even it it were possible to predict the quantity of water that nature would supply to any lake in any month.

150. The discharges of the St. Clair and Detroit rivers during the navigation season are comparatively uniform owing to the effect of the increased slopes in the rivers counteracting the effect of the decreased stages in the lakes. With the regulation of Lake Michigan-Huron, the discharge would be greatly increased during April, May, June, and July, and greatly decreased during August, September, October, and November. The latter are the critical months for the navigators. Any change in the flow of these two rivers, whereby the fluctuation in discharge would be increased, would prove a detriment to navigation.

151. Granting that the regulation of Lake Michigan-Huron could be accomplished by artificial works, the effect on the stage of water in the St. Clair River, Lake St. Clair and Detroit River would be so serious that any benefit derived from the increased depths in Lake Michigan-Huron would be more than offset by the decreased depths in the St. Clair River, Lake St. Clair, Detroit River, and the western end of Lake Erie.

152. At the present time, the stage of Lake Michigan-Huron is partially regulated by natural agencies. Nearly every winter, nature forms a regulating works in the St. Clair or Detroit river. These works consist of ice gorges, which retard the outflow from Lake Michigan-Huron, thereby storing water to be let out during the navigation season when it is so greatly needed in the lakes and connecting channels below Lake Michigan-Huron.

REGULATION OF LAKE ONTARIO.

153. To control the stage of Lake Ontario near some fixed level, regulating works could be constructed at the head of the Galop Rapids in the St. Lawrence River. These works would control the outflow from Lake Ontario and maintain the levels of the lake within definite limits. For perfect regulation, the storage in the lake must be discharged during the first half of the year and the outflow must be diminished by the amount of the negative storage during the last half of the year. An examination of Table 28 and Plate 18, shows that, for an average year, the monthly mean total supply to Lake Ontario has fluctuated between 297500 cubic feet per second, in May, and 225500 cubic feet per second, in January, while the monthly mean outflow has varied from 283600 cubic feet per second, in July, to 219300 cubic feet per second, in February. The maximum monthly mean total supply has been as large as 382400 cubic feet per second, in April, 1870, and as small as 154100 cubic feet per second, in February, 1875, while the maximum monthly mean discharge has been as large as 351200 cubic feet per second, in May, 1862, and as small as 152200 cubic feet per second,

in February, 1902. In order to accomplish perfect regulation without enlarging the river cross section, the stage of Lake Ontario must be held at such a level that the outflow can be as great as 382400 cubic feet per second, or 31200 cubic feet per second greater than the maximum discharge to date. This required maximum outflow is only 9 per cent. greater than the actual maximum. For the low-water year of 1895, the average total supply was 185700 cubic feet per second, while the average outflow was 191600 cubic feet per second. If the oscillations in the levels of Lake Ontario are to be decreased without exceeding the extreme high water of 248.95, then the level of the lake should be held at such a stage that it will never exceed this maximum limit in months of excessive supply. Two consecutive months of excessive supply occurred in April and May, 1862, when the water-yield was 375600 and 372000 cubic feet per second, respectively. The outflow through the St. Lawrence River at regulated stage 248.95 would be about 350500 cubic feet per second. With a maximum discharge through the regulating works, there would still have been an excess in supply of 25100 and 21500 cubic feet per second, corresponding to a rise in lake surface of 0.33 foot, in April, and 0.28 foot, in May, or a total of 0.61 foot in the two months. Hence, if the level of the lake, under regulation, were allowed to fall 0.6 foot, or to 248.35, after the close of the season of navigation, then the plane of regulation of Lake Ontario would probably never be exceeded.

154. Regulating works, designed to discharge about 150000 cubic feet per second, as a minimum, and 350500 cubic feet per second, as a maximum, could be located at the head of the Galop Rapids and would control the monthly mean level of Lake Ontario between 246.95 and 248.95, a range of 2 feet. This scheme of regulation would reduce the fluctuations in lake level from 5½ feet to within 2 feet, and would raise the mean level of Lake Ontario about 2 feet.

155. The effect on the stage of water in the St. Lawrence canals with this scheme of regulation of Lake Ontario would be to cause higher water in the first part and lower water in the last part of the navigation season. Such results would injuriously affect navigation.

COMPENSATING WORKS IN THE NIAGARA RIVER.

156. Your committee had hoped to present a discussion of a project for compensating Lake Erie for the loss of level due to diversions, by works placed above the rapids approaching Niagara Falls. A preliminary examination, however, revealed a lack of data, which prevents consideration of the question at this time.

E. E. Haskell,
Member, American Section.

Louis Coste,
Member, Canadian Section.

Attest : W. Edward Wilson, C. E.,
Secretary, American Section.

TABLE 2.

WATER LEVELS OF LAKE SUPERIOR.

Monthly mean elevations of water surface of Lake Superior, at Superior, Wis., and Marquette, Mich., in feet above mean tide at New York.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
*a*1860	*b*602.69	*b*602.44	*b*602.42	602.69	602.92	603.09	603.05	603.10	603.08	603.12	*b*602.95	*b*602.60	602.85
a 61	*b* 2.40	2.15	2 01	2.42	3.05	3.20	3.36	3.32	3.23	3.26	2.92	2.54	2.82
a 62	2.19	2.00	2.03	2.09	2.77	2.76	2.73	2.90	3.02	2.95	2.62	2.35	2.53
a 63	2.16	2.03	1.86	1.90	2.03	1.95	2.09	2.73	2.73	2.56	2.21	2.10	2.19
a 64	1.81	1.60	1.67	1.69	1.85	2.00	2.09	2.10	2.25	1.99	1.80	1.65	1.88
a 65	1.47	1.46	1.33	1.77	2.26	2.67	2.99	3.07	3.08	2.87	2.34	2.03	2.28
a 66	1.74	1.53	1.53	1.98	2.23	2.42	2.71	2.94	2.67	2.69	2.36	2.47	2.27
a 67	2.20	2.09	1.90	2.12	2.12	2.72	3.05	2.93	3.01	2.99	2.56	2.24	2.49
a 68	2.08	1.49	1.85	2.04	2.44	2.35	2.57	2.49	2.62	2.59	2.75	2.32	2.30
a 69	2.10	1.86	1.41	1.99	2.39	2.40	2.77	3.23	4.08	3.56	3.22	2.57	2.63
*a*1870	2.32	2.11	2.12	2.22	2.55	2.36	2.55	2.55	2.72	2.56	2.38	1.45	2.32
a 71	1.36	0.76	1.18	1.68	2.21	2.33	2.40	2.46	2.56	2.49	2.42	1.68	1.96
72	1.47	1.36	1.24	1.14	1.79	2.17	2.44	2.61	2.77	2.67	2.52	2.22	2.03
73	2.12	*c* 1.80	*c* 1.82	*c* 1.86	2.31	2.61	2.90	3.08	3.14	3.04	2.90	2.60	2.52
74	*c* 2.14	2.13	2.09	2.19	2.26	2.46	2.84	2.93	3.03	3.09	2.91	2.60	2.56
75	2.28	2.24	2.28	2.28	2.50	2.86	2.85	2.94	3.17	3.02	2.88	2.68	2.66
76	2.48	2.27	2.18	2.21	2.75	3.43	3.82	3.93	3.82	3.49	3.33	3.05	3.06
77	2.69	2.45	2.19	2.11	2.10	2.32	2.70	2.76	2.60	2.60	2.39	2.32	2.44
78	2.20	2.32	1.55	1.52	1.79	2.07	2.14	2.02	1.85	1.92	1.72	1.40	1.88
79	*c* 1.49	1.46	1.76	1.37	1.01	1.24	1.48	1.60	1.49	1.58	1.50	*c* 1.14	1.43
1880	*c* 0.99	*c* 0.98	*c* 0.89	*c* 1.92	*c* 1.52	2.30	2.45	2.44	2.44	2.39	2.33	2.07	1.89
81	1.81	1.71	1.62	1.53	1.83	2.27	2.33	2.38	2.61	2.95	2.88	2.60	2.21
82	2.25	2.00	1.89	1.81	1.97	1.99	2.44	2.56	2.60	2.43	2.41	2.22	2.21
83	1.99	1.70	1.70	1.95	1.96	2.06	2.31	2.33	2.29	2.09	1.94	1.83	2.01
84	*c* 1.80	*c* 1.63	*c* 1.54	1.32	1.54	1.74	1.88	1.89	2.16	2.52	2.42	2.21	1.89
85	1.98	1.80	1.72	1.67	2.00	2.28	2.52	2.64	2.57	2.40	2.25	1.92	2.15
86	1.72	1.59	1.53	1.62	1.87	2.01	2.08	1.99	1.97	2.07	1.92	1.78	1.85
87	1.47	1.49	1.80	1.97	1.76	1.92	2.20	2.28	2.14	2.07	1.83	1.61	1.88
88	1.50	1.51	1.44	1.44	1.91	2.69	2.88	3.02	2.97	2.88	2.74	2.39	2.28
89	2.07	1.85	1.68	1.69	2.04	2.16	2.35	2.54	2.67	2.51	2.20	1.90	2.14
1890	1.76	1.63	1.39	1.36	1.57	2.02	2.32	2.47	2.60	2.57	2.36	2.00	2.00
91	1.64	1.51	1.47	1.43	1.63	1.68	1.88 *d*	1.86 *d*	1.82 *d*	1.91 *d*	1.79	1.42	1.67
92	1.42	1.14	1.01	1.02	1.35	1.73	1.76	1.88	1.93	1.83	1.66	1.38	1.51
93	1.10	1.01	1.06	1.16	1.66	2.18	2.48	2.54	2.45	2.42	2.26	2.03	1.86
94	1.85	1.67	1.76	1.91	2.69	2.91	2.97	3.10	3.02	3.04	2.99	2.80	2.56
95	2.50	2.28	2.11	2.01	2.38	2.70	2.90	2.95	3.09	3.14	2.85	2.52	2.62
96	2.32	2.12	1.92	2.01	2.66	3.04	3.10	3.12	2.95	2.63	2.70	2.55	2.59
97	2.39	2.16	2.08	2.11	2.45	2.78	3.08	3.20	3.14	2.94	2.64	2.21	2.60
98	1.83	1.65	1.46	1.46	1.70	2.18	2.59	2.72	2.82	2.76	2.56	2.33	2.17
99	1.96	1.76	1.79	1.76	2.47	2.96	3.19	3.35	3.51	3.32	3.21	3.00	2.69
1900	2.63	2.45	2.23	2.13	2.30	2.36	2.58	2.94	3.46	3.54	3.51	3.13	2.77
01	2.78	2.48	2.28	2.22	2.51	2.61	3.09	3.22	3.04	3.07	3.00	2.68	2.75
02	2.32	2.11	1.97	2.02	2.34	2.64	2.88	2.89	2.93	2.81	*e* 2.81	*e* 2.58	2.52
e 03	2.24	1.98	1.88	2.07	2.56	2.94	3.14	3.25	3.27	3.40	3.18	2.80	2.73
e 04	2.50	2.33	2.23	2.17	2.47	2.77	2.86	2.95	3.08	3.26	3.19	2.74	2.71
e 05	2.47	2.13	2.04	2.25	2.49	2.67	2.97	3.10	3.32	3.33	3.17	2.96	2.74
e 06	2.72	2.43	2.22	2.15	2.48	2.78	2.90	2.93	2.95	2.84	2.66	2.45	2.63
e 07	2.22	2.06	1.94	1.94	2.10	2.55	2.70	2.93	3.17	3.15	2.88	2.53	2.51
Mean	602.03	601.85	601.77	601.86	602.16	602.42	602.63	602.73	602.79	602.74	602.56	602.26	602.32

Authority, U.S. Lake Survey, except for supplied values.

a.—Gage readings taken at Superior, Wis.

b.—Supplied by applying to the mean reading, for the following or preceding month, the mean rise or fall in stage between such months for the years 1861 or 1862 to 1871 inclusive.

c.—Supplied by adding to the Sault Ste. Marie readings the mean fall in the water surface between Marquette and Sault Ste. Marie for the years 1871 to 1888 inclusive.

d.—Supplied in like manner from years 1889 to 1901 inclusive.

e.—From self-registering gage.

NOTE.—Elevations depend on zero of gage 601.75 ft. and B. M. 3, 609.91 ft. U. S. Lake Survey, 1903 Levels.

TABLE 3.

WATER LEVELS OF ST. MARYS RIVER.

Monthly mean elevations of water surface of St. Marys River, at Southwest pier (above the locks) Sault Ste. Marie, Mich., in feet above mean tide at New York.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
*a*1860	602.22	601.95	601.93	602.18	602.55	602.74	602.74	602.80	602.72	602.76	602.58	602.18	602.45
a 61	1.93	1.66	1.52	1.91	2.68	2.85	3.05	3.02	2.87	2.90	2.55	2.12	2.42
a 62	1.72	1.51	1.54	1.58	2.40	2.41	2.42	2.60	2.66	2.59	2.25	1.93	2.13
a 63	1.69	1.54	1.37	1.39	1.66	1.60	1.78	2.41	2.37	2.20	1.84	1.68	1.79
a 64	1.34	1.11	1.18	1.18	1.48	1.65	1.78	1.80	1.89	1.63	1.43	1.23	1.48
a 65	1.00	0.97	0.84	1.26	1.89	2.32	2.68	2.77	2.72	2.51	1.97	1.61	1.88
a 66	1.27	1.04	1.04	1.47	1.86	2.07	2.40	2.64	2.31	2.33	1.99	2.05	1.87
a 67	1.73	1.60	1.41	1.61	1.75	2.37	2.74	2.63	2.65	2.63	2.19	1.82	2.09
a 68	1.61	1.00	1.36	1.53	2.07	2.00	2.26	2.19	2.26	2.23	2.38	1.90	1.90
a 69	1.63	1.37	0.92	1.48	2.02	2.05	2.46	2.93	3.72	3.20	2.85	2.15	2.23
1870	*a* 1.85	*a* 1.62	*a* 1.63	*a* 1.71	*a* 2.18	*a* 2.01	*a* 2.24	*a* 2.25	*a* 2.36	*a* 2.20	2.01	1.03	1.92
71	1.36	1.20	0.93	1.07	1.64	2.05	2.23	2.15	2.20	2.00	1.78	1.39	1.67
72	1.14	1.06	0.82	0.78	1.67	1.84	2.24	2.56	2.63	2.48	2.33	1.88	1.79
73	1.48	1.31	1.33	1.35	1.91	2.04	2.48	2.73	2.80	2.68	2.46	2.22	2.07
74	1.67	1.51	1.40	1.28	1.70	2.13	2.50	2.56	2.54	2.67	2.45	2.35	2.06
75	1.89	1.64	1.60	1.85	2.16	2.46	2.54	2.56	2.84	2.71	2.43	1.87	2.21
76	1.84	1.79	1.53	1.57	2.29	2.87	3.34	3.39	3.42	3.09	2.81	2.32	2.52
77	2.03	2.06	1.94	1.82	1.82	2.04	2.37	2.49	2.25	2.29	2.05	1.89	2.09
78	1.67	1.41	1.31	1.29	1.57	1.83	1.94	1.90	1.61	1.72	1.64	1.42	1.61
79	1.02	0.62	0.38	0.51	0.88	1.02	1.32	1.35	1.27	1.30	1.12	0.72	0.96
1880	0.52	0.49	0.40	0.41	1.15	1.91	2.15	2.03	2.19	1.96	1.99	1.71	1.41
81	1.40	1.30	1.32	1.21	1.63	1.86	2.06	1.98	2.17	2.63	2.53	2.20	1.86
82	1.69	1.47	1.35	1.30	1.71	1.80	2.15	2.25	2.19	2.10	2.04	1.77	1.82
83	1.34	1.25	1.25	1.32	1.31	1.68	1.86	2.28	1.95	1.80	1.69	1.43	1.60
84	1.33	1.14	1.05	0.88	1.25	1.35	1.57	1.61	1.68	1.77	1.87	1.61	1.43
85	1.44	1.33	1.19	1.02	1.60	1.94	2.12	2.34	2.10	1.92	1.85	1.55	1.70
86	1.20	1.04	1.04	1.02	1.50	1.66	1.83	1.97	1.83	1.86	1.79	1.36	1.51
87	1.14	1.00	0.97	0.83	1.19	1.64	2.01	1.89	1.75	1.93	1.70	1.29	1.44
88	1.13	0.79	0.84	0.83	1.43	2.28	2.44	2.43	2.35	2.34	2.14	1.80	1.73
89	1.52	1.23	1.26	1.25	1.81	1.99	2.26	2.27	2.26	2.11	1.81	1.43	1.77
1890	1.48	0.93	0.92	0.85	1.32	1.90	2.26	2.17	2.06	1.99	1.85	1.55	1.61
91	0.86	0.97	0.82	1.00	1.43	1.38	1.49	1.50	1.43	1.49	1.38	1.07	1.24
92	1.01	0.65	0.47	0.63	1.14	1.50	1.64	1.65	1.71	1.60	1.32	1.04	1.20
93	0.79	0.59	0.60	0.85	1.42	1.95	2.15	2.23	2.10	2.04	1.99	1.45	1.51
94	1.23	1.15	1.04	1.42	2.40	2.64	2.78	2.79	2.66	2.70	2.60	2.30	2.14
95	2.00	1.86	1.66	1.64	2.04	2.43	2.67	2.68	2.85	2.97	2.45	2.24	2.29
96	1.69	1.68	1.48	1.57	2.18	2.59	2.72	2.74	2.61	2.18	2.21	2.15	2.15
97	1.92	1.61	1.63	1.76	2.11	2.47	2.69	2.85	2.68	2.47	2.36	1.87	2.20
98	1.38	1.15	1.00	1.13	1.42	1.83	2.17	2.28	2.42	2.26	2.09	2.01	1.76
99	1.53	1.37	1.26	1.26	2.12	2.56	2.76	2.91	3.10	2.77 *b*	2.69 *b*	2.64	2.25
b 1900	2.03	1.90	1.64	1.68	1.87	1.94	2.17	2.39	2.90	2.93	3.04	2.63	2.26
b 01	2.17	1.87	1.65	1.76	2.06	2.15	2.56	2.74	2.60	2.72	2.66	2.27	2.27
b 02	1.90	1.61	1.53	1.69	1.88	2.25	2.48	2.49	2.54	2.39	2.46	2.29	2.13
b 03	1.83	1.60	1.51	1.76	2.15	2.57	2.70	2.80	2.82	2.98	2.85	2.41	2.33
b 04	1.87	1.64	1.40	1.76	2.09	2.34	2.48	2.55	2.65	2.82	2.71	2.30	2.22
b 05	2.00	1.59	1.36	1.78	2.07	2.25	2.60	2.73	2.92	2.96	2.73	2.52	2.29
b 06	2.18	1.85	1.63	1.70	2.02	2.30	2.50	2.46	2.46	2.36	2.19	1.95	2.13
b 07	1.62	1.43	1.34	1.59	1.71	2.12	2.33	2.50	2.70	2.71	2.56	2.08	2.06
Mean	601.55	601.34	601.24	601.35	601.80	602.08	602.31	602.40	602.41	602.35	602.18	601.86	601.91

Authority, U.S. Lake Survey, except for supplied values.

a.—Values supplied by subtracting from the Superior, Wis, readings the mean fall in water surface between Superior and Sault Ste. Marie for the years 1860 to November, 1870, inclusive.

b.—From self-registering gage.

NOTE.—Elevations depend on B.M. " A " 606.069 ft., U.S. Lake Survey, 1903 Levels.

TABLE 4.

WATER LEVELS OF LAKE MICHIGAN.

Monthly mean elevations of water surface of Lake Michigan, at Milwaukee, Wis., in feet above mean tide at New York.

YEAR	JAN.	FEB.	MAR.	APR L	MAY	JUNE	JULY	AUG.	SE T.	OCT.	NOV.	DEC.	MEAN
1860	582.51	582.69	582.72	582.85	582.97	583.09	583.13	582.94	582.74	582.43	582.10	581.94	582.68
61	1.83	1.92	2.31	2.41	2.83	2.99	3.12	3.36	3.05	2.93	2.70	2.53	2.66
62	2.33	2.18	2.48	2.64	2.89	3.02	2.92	2.91	2.84	2.73	2.34	2.20	2.62
63	2.13	2.18	2.17	2.17	2.38	2.47	2 42	2.29	2.11	2.02	1.58	1.92	2.15
64	1.69	1.55	1.80	1.51	2.02	2.01	1.91	1.73	1.46	1.07	0.90	0.77	1.54
65	0.56	0.65	0.82	1.31	1.47	1.51	1.94	1.96	1.84	1.60	1.04	0.73	1.29
66	0.47	0.23	0.28	0.73	0.91	1.20	1 46	1.52	1.37	1.26	1.17	0.91	0.96
67	0.89	0.94	1.12	1.41	1.63	1.94	2.09	2.02	1.75	1.42	0.96	0.61	1.40
68	0.45	0.41	1.09	0.99	1.27	1.48	1.51	1.17	0.93	0.70	0.63	0.35	0.92
69	0.25	0.32	0.06	0.43	0.76	1.29	1.67	1.93	1.82	1.46	1.34	1.06	1.03
1870	1.12	1.21	1.51	1.93	2.27	2.41	2.52	2.43	2.57	2.17	1.77	1.42	1.94
71	1.57	1.49	2.09	2.29	2.64	2.68	2.71	2.48	1.81	1.12	1.07	0.48	1.87
72	0.35	0.35	0.13	0.38	0.63	1.00	1.03	1.01	0.94	0.82	0.53	579.87	0.59
73	579.87	579.91	0.22	0.79	1.35	1.98	1.94	2.04	1.85	1.79	1.56	581.52	1.24
74	581.48	581.77	1.92	1.82	1.80	2.17	2.10	2.11	1.86	1.51	1.31	0.97	1.74
75	0.77	0.70	0.76	1.12	1.68	1.92	1.89	2.06	1.99	1.84	1.63	1.44	1.48
76	1.39	1.59	1.92	2.12	2.74	3.15	3.49	3.42	3.37	2.79	2.89	2.42	2.61
77	2.28	2.29	2.29	2.67	2.56	2.63	2.60	2.48	2.27	2.28	2.16	2.10	2 38
78	1.98	1.91	2.07	2.09	2.39	2.53	2.54	2.22	2.02	1.91	1.78	1.46	2.08
79	1.15	1.16	1.20	1.19	1.32	1.39	1.48	1.29	1.17	0.95	0.73	0.76	1.15
1880	0.80	0.71	0.75	0.92	1.26	1.77	1.99	2.02	1.72	1.38	1.06	0.89	1.27
81	0.90	1.11	1.40	1.31	1.82	2.05	2.02	2.02	1.79	2.12	1.95	1.85	1.70
82	1.63	1.62	1.99	2.12	2.22	2.49	2.62	2.81	2.69	2.28	2.07	1.74	2.19
83	1.48	1.52	1.61	1.82	2.30	2.66	3.26	3.23	3.04	2.82	2.37	2.29	2.37
84	2.07	2.19	2.44	2.62	2.83	2.99	2.83	2.69	2.44	2.44	2.08	2.05	2.47
85	2.06	2.29	2.25	2.44	2.80	3.01	3.10	3.31	3.17	3.03	2.73	2.44	2.72
86	2.67	2.69	2.97	3.24	3.50	3.57	3.38	3.15	2.91	2.81	2.47	2.14	2.96
87	2.06	2.43	2.59	2.54	2.74	2.87	2.81	2.67	2.33	1.88	1.55	1.43	2.32
88	1.25	1.20	1.38	1.59	1.97	2.24	2.25	2.13	1.98	1.73	1.68	1.10	1.71
89	1.08	1.05	1.03	1.04	1.12	1.58	1.76	1.52	1.35	1.10	0.75	0.57	1.16
1890	0.65	0.61	0.59	0.91	1.14	1.55	1.62	1.54	1.34	1.23	0.89	0 54	1.05
91	0.52	0.28	0.47	0.78	0.88	1.03	0.86	0.79	0.56	0.20	579.80	579.74	0.49
92	579.86	0.05	579.95	0.01	0.43	0.88	0.89	0.97	0.77	0.53	580.26	9.99	0.38
93	9.98	0.12	580.23	0.69	0.99	1.32	1.34	1.17	0.85	0.71	0.32	580 25	0 66
94	580 26	0.29	0.55	0.70	1.24	1.40	1.43	1.35	0.92	0.71	0.44	0.09	0.78
95	579.91	579.80	579.77	579.97	0.13	0.18	0.07	579.95	579 68	579.31	579.09	578.98	579.74
96	9.06	9.10	9.11	9.29	579.57	579.89	579.83	9.76	9.66	9.61	9.39	9.34	9.47
97	9.33	9.41	9.72	9.89	580.38	580.65	580.84	508.78	589.53	580.24	9.98	9.76	580 13
98	9.72	9.86	580.18	580.50	0.78	0.91	0.89	0 69	0 34	0.33	9.92	9.58	0.31
99	9.53	9.61	579.81	0.08	0.52	0.83	1.04	0.96	0.82	0.49	580.31	9 81	0 32
1900	9.66	9.77	9.94	0.07	0.31	0.42	0.53	0.70	0.65	0.66	0.52	580.19	0 28
01	9.95	9.92	508.34	0.49	0.92	0.97	1.06	1.11	0 92	0.56	0.23	579.95	0.54
02	9.76	9.61	579.84	579.91	0.30	0.50	0.83	0.85	0.48	0.33	0.20	9.91	0.22
03	9.69	9.85	580.06	580.33	0.43	0.61	0.79	0.72	0.77 *a*	0.50 *a*	0.14 *a*	9 88	0 31
a 04	9.90	9.86	0.14	0.60	0.95	1.35	1 36	1.26	1.19	1.06	0.75	580.44	0.74
a 05	580.27	580.21	0.33	0.71	0.97	1.36	1.54	1.51	1.41	0.97	0.71	0 55	0 88
06	*a* 0.53	*a* 0.68	*a* 0.83	*a* 1.01	1.27	1.39	1.44	1 41	1.06	0 86	0.68	0.69	0 99
07	0.60	0.64	0.70	0.96	1.12	1 48	1.48	1.38	1.37	1.16	0.74	0 63	1.02
Mean	580 84	580.87	581 04	581.24	581.53	581 77	581.84	581.79	581 59	581.37	581.11	580.88	581.32

Authority, U.S. Lake Survey.

a.—Self-registering gage on harbor pier.

NOTE.—Elevations depend on check point (1876) on Chestnut St. Bridge (destroyed) as 586.55 ft. and check point (1902) on same bridge as 584.47 ft., U.S. Lake Survey, 1903 Levels.

TABLE 5.

WATER LEVELS OF LAKE HURON.

Monthly mean elevations of water surface of Lake Huron, at Harbor Beach, Mich., in feet above mean tide at New York.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
1860	582.83	582.78	582.92	582.89	582.94	583.18	583.27	583.19	583.00	582.62	582.50	582.20	582.86
61	1.99	2.03	2.17	2.37	2.99	3.33	3.45	3.56	3.48	3.26	2.95	2.82	2.87
62	2.44	2.43	2.34	2.55	2.92	3.04	3.09	3.07	2.85	3.13	2.81	2.52	2.77
63	2.36	2.21	2.16	2.23	2.55	2.68	2.59	2.60	2.46	2.20	2.16	1.93	2.34
64	1.79	1.75	1.75	1.95	2.38	2.39	2.34	2.23	1.91	1.38	1.21	1.08	1.85
65	0.72	0.81	0.98	1.47	1.63	1.67	2.10	2.12	2.00	1.76	1.20	0.89	1.45
66	0.63	0.39	0.44	0.88	1.07	1.36	1.62	1.68	1.53	1.42	1.33	1.07	1.12
67	1.05	1.10	1.28	1.57	1.79	2.10	2.25	2.18	1.91	1.58	1.12	0.77	1.56
68	0.61	0.57	1.25	1.15	1.43	1.64	1.67	1.33	1.09	0.86	0.79	0.51	1.08
69	0.41	0.48	0.22	0.59	0.92	1.45	1.83	2.09	1.98	1.62	1.50	1.22	1.19
1870	1.28	1.37	1.67	2.09	2.43	2.57	2.68	2.59	2.73	2.33	1.93	1.58	2.10
71	1.73	1.65	2.25	2.45	2.80	2.84	2.87	2.56	2.24	1.74	1.53	1.16	2.15
72	0.99	0.79	0.29	0.71	1.11	1.51	1.61	1.58	1.48	1.36	1.06	0.77	1.10
73	0.60	0.57	0.64	1.05	1.55	1.95	2.15	2.16	1.99	1.96	1.86	1.70	1.52
74	1.72	1.86	2.00	1.85	1.90	2.24	2.40	2.29	2.11	1.84	1.30	1.45	1.91
75	1.16	1.10	1.14	1.33	1.68	1.99	2.18	2.15	2.19	2.00	1.89	1.62	1.70
76	1.74	1.72	1.85	2.13	2.73	3.22	3.66	3.60	3.49	3.09	2.94	2.75	2.74
77	2.46	2.45	2.38	2.46	2.63	2.59	2.77	2.67	2.40	2.26	2.21	2.16	2.45
78	2.06	1.89	2.06	1.99	2.39	2.56	2.69	2.50	2.21	2.22	2.03	1.83	2.20
79	1.53	1.29	1.25	1.28	1.41	1.55	1.59	1.46	1.38	1.14	1.02	1.00	1.32
1880	1.05	0.99	0.98	0.99	1.39	1.88	2.19	2.08	1.97	1.61	1.49	1.29	1.49
81	1.16	1.55	1.56	1.58	1.90	2.07	2.22	2.05	1.89	2.14	2.27	2.10	1.87
82	1.95	1.72	1.86	2.08	2.25	2.48	2.62	2.68	2.56	2.33	2.08	1.93	2.21
83	1.73	1.68	1.72	1.73	2.30	2.72	3.20	3.40	3.08	2.75	2.86	2.75	2.49
84	2.56	2.41	2.45	2.76	2.98	3.04	3.12	3.00	2.65	2.81	2.46	2.20	2.70
85	2.47	2.38	2.38	2.49	2.89	3.18	3.24	3.39	3.29	3.06	2.87	2.67	2.86
86	2.67	2.74	2.93	3.22	3.55	3.64	3.48	3.33	3.15	3.02	2.75	2.43	3.08
87	2.26	2.45	2.66	2.57	2.77	2.89	2.97	2.76	2.41	2.19	1.74	1.45	2.43
88	1.34	1.25	1.42	1.56	2.00	2.30	2.33	2.37	2.08	1.78	1.60	1.39	1.78
89	1.25	1.17	1.15	1.08	1.22	1.55	1.81	1.75	1.58	1.21	0.87	0.71	1.28
1890	0.78	0.66	0.64	0.78	1.09	1.52	1.71	1.71	1.44	1.23	1.03	0.73	1.11
91	0.53	0.42	0.39	0.72	0.96	0.91	0.94	0.84	0.65	0.28	579.97	579.91	0.54
92	579.93	579.87	579.93	0.05	0.14	0.67	0.96	1.04	0.87	0.66	580.33	580.09	0.38
93	9.84	9.79	9.87	0.25	0.88	1.21	1.35	1.21	0.91	0.73	0.47	0.28	0.57
94	580.23	580.24	580.39	0.62	1.02	1.32	1.47	1.20	1.01	0.77	0.58	0.28	0.76
95	579.96	579.84	579.85	579.95	0.12	0.19	0.16	0.07	579.94	579.65	579.26	579.02	579.83
96	9.09	9.21	9.11	9.14	579.54	579.91	579.97	0.01	9.83	9.63	9.49	9.38	9.53
97	9.45	9.36	9.47	9.84	580.41	580.65	580.83	0.84	580.58	580.23	580.07	9.81	580.13
98	9.66	9.72	9.95	580.44	0.56	0.72	0.82	0.71	0.52	0.21	0.13	9.94	0.28
99	9.68	9.54	9.69	579.86	0.40	0.79	1.08	0.99	0.79	0.38	0.24	580.05	0.29
1900	9.82	9.83	9.86	9.98	0.13	0.30	0.55	0.64	0.72	0.66	0.66	0.46	0.30
01	580.22	580.08	580.07 *a*	580.55 *a*	0.81 *a*	0.91 *a*	1.06 *a*	1.11 *a*	0.88 *a*	0.66 *a*	0.43 *a*	0.10	0.57
a 02	0.00	579.81	579.73	579.91	0.16	0.48	0.76	0.83	0.51	0.27	0.17	579.93	0.22
a 03	579.74	9.78	9.92	580.27	0.39	0.56	0.75	0.73	0.80	0.83	0.41	580.12	0.36
a 04	9.91	9.91	580.08	0.63	0.96	1.42	1.55	1.53	1.36	1.26	0.95	0.50	0.84
a 05	580.38	580.30	0.29	0.66	0.95	1.40	1.57	1.56	1.45	1.22	0.93	0.67	0.95
a 06	0.53	0.69	0.76	0.94	1.20	1.33	1.45	1.36	1.12	0.87	0.68	0.65	0.96
a 07	0.65	0.68	0.68	0.90	1.08	1.39	1.64	1.49	1.42	1.21	0.83	0.62	1.05
Mean	581.02	580.99	581.06	581.26	581.57	581.82	581.97	581.92	581.75	581.53	581.31	581.09	581.44

Authority, U.S. Lake Survey (see page 4105, appendix EEE. Annual Report of the Chief of Engineers for 1904).

a.—Self-registering gage.

NOTE.—Elevations depend on gage bolt "E" 583.21 ft., B.M. "Jenks" 610.56 ft., U.S. Lake Survey, 1903 Levels.

TABLE 6.

WATER LEVELS OF ST. CLAIR RIVER.

Monthly mean elevations of water surface of St. Clair River, at Grand Trunk Railway (G.T.R.), in feet above mean tide at New York.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
a1869	582.06	582.02	582.14	581.82	581.86	582.08	582.16	582.08	581.92	581.58	581.47	581.20	581.87
a 61	1.31	1.35	1.47	1.36	1.91	2.21	2.32	2.41	2.34	2.15	1.87	1.76	1.87
a 62	1.71	1.70	1.62	1.52	1.84	1.95	2.00	1.98	1.78	2.03	1.75	1.49	1.78
a 63	1.64	1.51	1.46	1.23	1.52	1.63	1.55	1.56	1.44	1.20	1.17	0.96	1.41
a 64	1.14	1.10	1.10	0.98	1.36	1.37	1.33	1.23	0.95	0.48	0.32	0 21	0.96
a 65	0.18	0.26	0.42	0.56	0.70	0.73	1.12	1.13	1.03	0.81	0.32	0.04	0.61
a 66	0.10	579 89	579.93	0.03	0.20	0.46	0.69	0.74	0.61	0.51	0.43	0.20	0.32
a 67	0.48	580.52	580.68	0.64	0.84	1.12	1.25	1.19	0.95	0.65	0.24	579.93	0.71
a 68	0.09	0.05	0.56	0.27	0.52	0.71	0.73	0.43	0.22	0.01	579.95	9.70	0.27
a 69	579.91	579.97	579.74	579.77	0.07	0.54	0.88	1.11	1.01	0.69	580.58	580.33	0.38
a1870	580 68	580.76	581.03	581.11	1.41	1.53	1.63	1.55	1.68	1.32	0.96	0.65	1.19
a 71	1.08	1.01	1.54	1.43	1.74	1.77	1.80	1.52	1.24	0.80	0.61	0.28	1.24
a 72	0.42	0.25	579.80	579.88	0.24	0.59	0.68	0.65	0.56	0.46	0.19	579.93	0.30
a 73	0.08	0.05	580.11	580.18	0.63	0.98	1.16	1.17	1.02	0.99	0.90	580.76	0.67
a 74	1.07	1.20	1.32	0.89	0.94	1.24	1.38	1.28	1.12	0.88	0.40	0.54	1.02
a 75	0.57	0.52	0.56	0.43	0.74	1.02	1.19	1.16	1.20	1.03	0.93	0.69	0.84
a 76	1.09	1.07	1.19	1.14	1.68	2.11	2.50	2.45	2.35	2.00	1.86	1.69	1.76
a 77	1.73	1.72	1.66	1.44	1.59	1.55	1.71	1.62	1.38	1.26	1.21	1.17	1.50
a 78	1.38	1.22	1.38	1.02	1.37	1.52	1.56	1.47	1.21	1.22	1.05	0.88	1.27
a 79	0.90	0.69	0.66	0.39	0.50	0.63	0.66	0.55	0.48	0.26	0.16	0.14	0.50
a1880	0.48	0.42	0.42	0.13	0.48	0.92	1.20	1.10	1.00	0.68	0.57	0.40	0.65
a 81	0.58	0.92	0.93	0.65	0.94	1.09	1.22	1.07	0.93	1.15	1.27	1.12	0.99
a 82	1.28	1.07	1.20	1.10	1.25	1.45	1.58	1.63	1.52	1.32	1.10	0.96	1.29
a 83	1.08	1.04	1.07	0.79	1.29	1.67	2.09	2.27	1.99	1.69	1.79	1.69	1.54
a 84	1.82	1.69	1.72	1.70	1.90	1.95	2.02	1.92	1.60	1.75	1.44	1.20	1.73
a 85	1.74	1.66	1.66	1.46	1.82	2.08	2.13	2.26	2.17	1.97	1.80	1.62	1.86
a 86	1.92	1.98	2.15	2.11	2.41	2.49	2.34	2.24	2.05	1.93	1.69	1.41	2.06
a 87	1.55	1.72	1.91	1.53	1.71	1.82	1.89	1.70	1.39	1.20	0.80	0.54	1.48
a 88	0.74	0.66	0.81	0.64	1.03	1.29	1.32	1.36	1.09	0.83	0.67	0.48	0.91
a 89	0.66	0.58	0.57	0.21	0.33	0.63	0.86	0.80	0.55	0.32	0.02	579.88	0.45
a1890	0.24	0.13	0.11	579.94	0.22	0.60	0.77	0.77	0.53	0.34	0.16	9.90	0 31
a 91	0.01	579.92	579.89	9.89	0.10	0.06	0.08	0.00	579.83	579.50	579.22	9.17	579.81
a 92	579.48	9.43	9.48	9.26	579.37	579.84	0.10	0.17	580.02	9.84	9.54	9.33	9.66
a 93	9.40	9.36	9.43	9.47	580.03	580.70	0.45	0.32	0.07	9.88	9.68	9.50	9.86
a 94	9.75	9.76	9.89	9.80	0.16	0.42	0.56	0.32	0.15	9.93	9.76	9.50	580.00
a 95	9.57	9.46	9.47	9.27	579.40	579.48	579 45	579.37	579.26	9.00	8.65	8.44	579.24
a 96	8 80	8.90	8.81	8.55	8.90	9.23	9.28	9.32	9.16	8.98	8.86	8.75	8 96
a 97	9.12	9.04	9.16	9.17	9.68	9.89	580.05	580.06	9.83	9.52	9.41	9.14	9.51
a 98	9.30	9.36	9.56	9.70	9.81	9.95	0.04	579.94	9.77	9.50	9.43	9.26	9.64
99	a 9.32	a 9.20	b9.33	b 9.21	b 9.58	b580.02	b 0.30	b580.24	b580.05	b 9.60	b 9.47	b 9.28	9.63
b1900	9.39	9.47	9.47	9.22	9.43	579.58	579.80	579.87	579.85	9.77	9.75	9.52	9.59
b 01	9.57	9.76	9.56	580.02	9.99	9.98	580.17	580.26	580.02	9.79	9.58	9.32	9.84
b 02	9.53	9.34	8.95	579.11	9.32	9.63	579.95	0.01	579.73	9.55	9.35	9.18	9.47
b 03	9.37	9.44	9.28	9.52	9.56	9.77	9.90	579.93	9.96	9.94	9.54	9.41	9.64
b 04	9.46	9.50	9.54	9.90	580.12	580.53	580.56	580.55	580.46	580.32	580.07	9.77	580.06
b 05	580.18	580 07	9.79	9.83	0.07	0.50	0.70	0.70	0.57	0.31	0.04	580.78	0.30
b 06	579.75	0.30	580.23	580.11	0.30	0.38	0.57	0.49	0.27	0.04	579.88	0.07	0.20
b 07	580.13	0.39	0.12	0.08	0.22	0.49	0.66	0.63	0.53	0.33	9.90	579.74	0.27
Mean	580.46	580.45	580.48	580.38	580.65	580.88	581.00	580.97	580.81	580.61	580.41	580.25	580.61

Authority, U.S. Lake Survey, except for supplied values.

a.—Supplied for Harbor Beach readings for the summer months, April to December, inclusive, by formula (G.T.R.—578) = 0.889 (Harbor Beach—578)—0.529 : and for winter months, January to March, inclusive, by formula (G.T.R.—578) = 0.889 (Harbor Beach—578)—0.235.

b.—Self-registering gage.

NOTE.—Elevations depend on B.M. Fort Gratiot Light-house (1877) as 590.342 ft., U.S. Lake Survey, 1903 Levels.

TABLE 7.

WATER LEVELS OF LAKE ST. CLAIR.

Monthly mean elevations of water surface of Lake St. Clair, at the St. Clair Flats Canal, in feet above mean tide at New York.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
*a*1860	576.31	574.84	575.94	576.50	576.89	577.03	576.40	576.30	575.90	576.59	75.68	576.29	576.22
b 61	6.37	4.93	6.02	6.77	6.83	7.03	7.00	7.17	6.98	6.78	6.64	6.64	6.60
b 62	6.29	5.14	6.07	7.24	7.24	7.28	7.27	7.15	6.94	6.74	6.43	6.30	6.67
b 63	6.48	6.41	6.15	6.63	6.90	6.77	6.83	6.79	6.61	6.11	5.94	5.90	6.46
b 64	6.14	5.50	5.61	6.30	6.70	6.90	6.67	6.47	6.29	5.80	5.72	5.83	6.16
65	*b* 4.53	*b* 3.78	*b* 4.48	*b* 5.64	*b* 6.17	*b* 6.21	*b* 6.40	*c* 6.38	*c* 6.32	*c* 6.11	*c* 5.66	*c* 5.52	5.60
66	*b* 5.42	*c* 4.91	*c* 4.96	*c* 5.72	*c* 5.84	*c* 6.13	*c* 6.39	*c* 6.24	*c* 6.18	*c* 6.18	*c* 6.03	*c* 6.20	5.85
c 67	5.30	5.28	4.82	6.06	6.46	6.84	6.70	6.61	6.25	5.90	5.42	5.30	5.91
68	*d* 5.27	*d* 4.15	*d* 5.43	*c* 5.64	*c* 6.10	*c* 6.41	*c* 6.34	*c* 6.00	*c* 5.78	*c* 5.40	*c* 5.15	*c* 5.12	5.57
69	*d* 4.81	*d* 4.39	*d* 4.58	*c* 5.35	*c* 5.45	*c* 6.00	*c* 6.48	*c* 6.48	*c* 6.28	*c* 5.87	*c* 5.60	*d* 5.95	5.60
1870	*d* 6.79	*d* 5.52	*d* 5.52	*c* 6.38	*c* 6.74	*c* 6.80	*c* 7.04	*c* 6.98	*c* 6.74	*c* 6.34	*c* 6.11	*c* 6.10	6.42
71	*d* 5.71	*d* 4.71	*c* 6.40	*c* 6.48	*c* 6.72	*c* 6.78	*c* 6.82	*c* 6.63	*c* 6.36	*c* 5.78	*c* 5.60	*d* 5.83	6.15
72	*d* 5.09	*d* 4.98	*d* 4.70	*c* 5.12	*c* 5.32	*c* 5.74	5.47	5.61	5.47	5.45	4.96	4.92	5.24
73	4.42	4.65	4.99	5.87	5.89	6.16	6.30	6.29	6.06	5.81	5.62	5.83	5.66
74	5.05	4.41	5.84	6.06	6.02	6.23	6.40	6.31	6.10	5.86	5.57	5.26	5.76
75	5.11	5.04	5.20	5.21	5.78	5.95	6.18	6.11	5.96	5.79	5.61	5 51	5.62
76	5.66	6.11	6.89	6.86	6.63	7.52	7.68	7.51	7.04	6.71	6.60	7.45	6.89
77	6.98	5.52	4.24	5.20	5.45	6.28	6.53	6.44	6.19	*c* 6.12	6.24	6.03	5.94
78	5.92	5 00	5.16	*b* 6.47	*b* 6.63	6.68	6.80	6.71	6.37	6.18	5.85	5.61	6.12
79	5 20	4.51	5.20	5.75	5.63	*b* 5.90	*b* 6.01	*b* 5.80	*b* 5.61	*b* 5.32	*b* 5.02	*b* 5.25	5.43
*b*1880	5.52	5.07	5.50	5.66	5.84	6.23	6.19	6.27	6.02	5.68	5.51	6.18	5.81
81	*b* 4.60	*b* 5.05	*b* 5.06	*b* 5.67	*b* 6.01	*b* 6.31	*b* 6.32	*b* 6.20	6.07	5.87	*e* 6.00	*c* 6.13	5.77
82	*e* 6.40	*e* 6.02	*e* 6.53	*e* 6.57	6.99	*e* 6.81	7.41	7.40	*e* 6.76	*e* 6.45	6.17	*c* 6.67	6.68
83	*e* 6.28	*e* 6.00	*c* 5.39	*e* 5.95	6.34	7.07	7.74	7.66	7.20	6.83	6.39	6.36	6.60
84	4.93	5.38	6.75	6.99	7.16	7.33	7.38	7.09	6.73	6.51	6.14	6.32	6.56
85	6.82	6.02	6.86	6.88	6.73	7.10	7.01	7.12	6.97	6.65	6.61	6.59	6.78
86	5.75	4.86	5.64	6.30	6.99	7.04	7.05	6.93	6.78	6.62	6.28	6.55	6.40
87	6.24	6.35	6.35	6.55	6.77	6.86	6.86	6.68	6.40	6.07	5.65	5.61	6.37
88	5.67	5.45	5.16	5.81	5.83	6.04	6.33	6.23	5.99	5.71	5.58	5.47	5.77
89	5.71	4.77	4.68	4.98	5.36	5.91	6.05	5.90	5.70	5.31	5.03	4.96	5.36
1890	5.44	5.29	5.26	5.65	5.91	6.34	6.27	6.03	5.79	5.57	5.54	5.39	5.71
91	4.97	5.07	4.86	5.23	5.18	5.29	5.36	5.25	5.12	4.80	4.56	4.64	5.03
92	4 26	3.51	3.70	4.53	5.07	5.69	5.89	5.71	5.60	5.15	4.76	4.54	4.87
93	3.70	3.80	4.64	5.07	5.48	5.82	5.86	5.68	5.42	5.16	4.88	4.98	5.04
94	4.99	4.49	4.86	5.01	5.46	5.69	5.73	5.53	5.38	5.12	4.88	4.82	5.16
95	5 28	5.29	4.69	4.19	4.49	4.63	4.69	4.65	4.53	4.13	3.84	4.12	4.54
96	4.17	3.33	3.57	4.09	4.34	4.70	4.87	5.03	4.71	4.61	4.15	4.13	4.31
97	4.42	4.77	4 72	4.77	5.18	5.28	5.43	5.40	5.14	4.78	4.61	4.64	4.93
98	4 58	4.10	4.73	5.17	5.29	5.49	5.54	5.40	5.13	4.87	4.82	4.90	5.00
99	4 80	4.57	4.53	4.65	5.07	5.34	5.51	5.45	5.14	4.84	4.71	4.65	4.94
1900	4.18	4.29	4.77	4.87	4.98	5.15	5.23	5.28	5.16	5.01	4.88	4.74	4.88
01	4 59	3.68	3.96	3.17	4.27	5.03	5.24	5.24	5.22	4.90	4.61	4.64	4.55
02	*f* 3.70	*f* 3.29	*f* 4.26	4.46	4.70	5.07	5.70	5.56	5.28	5.18	4.89	4.99	4.76
03	5 19	*f* 4.73	*f* 5.05	*f* 5.57	5 36	5.49	5.62	5.54	5.53	5.39	4.89	5.29	5.30
04	4 12	4.44	5.58	5.85	5.80	6.13	6.19	6.08	5.92	5.68	5.28	5.39	5.54
05	4 46	4.14	4.75	5.05	5.39	5.82	6.01	5.95	5.78	5.54	5.26	5.11	5.27
06	*f* 5.25	*f* 4.32	*f* 4.30	*f* 5.14	*f* 5.40	*f* 5.61	*f* 5.81	*f* 5.76	*f* 5.55	5.37	5.44	5 32	*f* 5.27
07	5.49	4 99	5.02	5.64	5.78	6.11	6.27	*f* 5.98	*f* 5.76	*f* 5.69	*f* 5.35	*f* 5.32	5.62
Mean	575 30	574 85	575 20	575.64	575.89	576.17	576.28	576.19	575.96	575.72	575.48	575.53	575.68

Authority, U.S. Lake Survey, except for supplied values.

a.—Deduced by subtracting 0.67 foot from St. Clair Flats values (U.S.L.S. Report, 1904) to obtain original values at Old Detroit Waterworks, then supplying by formula (Fall St. Clair Flats to Amherstburg) = 0.9378 (Fall Old Detroit Waterworks to Amherstburg) + 0.853.

b.—Supplied by formula (Fall St. Clair Flats to Amherstburg) = 1.0357 (Fall Light-house Depot to Amherstburg) + 0.377.

c.—Supplied by using mean of two values derived from equations (Fall St. Clair Flats to Amherstburg) = 0.9378 (Fall Old Detroit Waterworks to Amherstburg) + 0.853; and (Fall St. Clair Flats to Amherstburg) = 1.0357 (Fall Light-house Depot to Amherstburg) + 0.377.

d.—Supplied by formula (Fall St. Clair Flats to Amherstburg) = 0.9378 (Fall Old Detroit Waterworks to Amherstburg) + 0.853.

e.—Derived by first subtracting 0.477 foot from New Detroit Waterworks' readings and then applying the mean monthly fall from St. Clair Flats to New Detroit Waterworks, as deduced from observations taken at those points from January, 1899 to June, 1901, inclusive.

f.—Derived from observations taken at Windmill Point by applying the mean monthly fall from St. Clair Flats Canal to Windmill Point as determined from simultaneous observatons taken at those points from January, 1897, to July, 1907, inclusive.

NOTE.—Elevations depend on zero of gage 575.36 ft., and P.B.M., "Upper Light," 581.76 ft., U.S. Lake Survey, 1903 Levels.

TABLE 8.

WATER LEVELS OF LAKE ST. CLAIR.

Monthly mean elevations of water surface of Lake St. Clair, at Windmill Point, near the outlet of Lake St. Clair, in feet above mean tide at New York.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
*a*1860	575.92	574.51	575.64	576.24	576.69	576.84	576.17	576.08	575.65	576.30	575.38	575.93	575.95
a 61	5.98	4.60	5.72	6.51	6.63	6.84	6.77	6.95	6.73	6.49	6.34	6.28	6.32
a 62	5.90	4.81	5.77	6.98	7.04	7.09	7.04	6.93	6.69	6.45	6.13	5.94	6.40
a 63	6.09	6.08	5.85	6.37	6.70	6.58	6.60	6.57	6.36	5.82	5.64	5.54	6.18
a 64	5.75	5.17	5.31	6.04	6.50	6.71	6.44	6.25	6.04	5.51	5.42	5.47	5.88
a 65	4.14	3.45	4.18	5.38	5.97	6.02	6.17	6.16	6.07	5.82	5.36	5.16	5.32
a 66	5.03	4.58	4.66	5.46	5.64	5.94	6.16	6.02	5.93	5.89	5.73	5.84	5.57
a 67	4.91	4.95	4.52	5.80	6.26	6.65	6.47	6.39	6.00	5.61	5.12	4.94	5.64
a 68	4.88	3.82	5.13	5.38	5.90	6.22	6.11	5.78	5.53	5.11	4.85	4.76	5.29
a 69	4.42	4.06	4.28	5.09	5.25	5.81	6.25	6.26	6.03	5.58	5.30	5.59	5.33
*a*1870	6.40	5.19	5.22	6.12	6.54	6.61	6.81	6.76	6.49	6.05	5.81	5.74	6.14
a 71	5.32	4.38	6.10	6.22	6.52	6.59	6.59	6.41	6.11	5.49	5.30	5.47	5.88
a 72	4.70	4.65	4.40	4.84	5.12	5.55	5.24	5.39	5.22	5.16	4.66	4.56	4.96
a 73	4.03	4.32	4.69	5.61	5.69	5.97	6.07	6.07	5.81	5.52	5.32	5.47	5.38
a 74	4.66	4.08	5.54	5.80	5.82	6.04	6.17	6.09	5.85	5.57	5.27	4.96	5.48
a 75	4.72	4.71	4.90	4.95	5.58	5.76	5.95	5.89	5.71	5.50	5.31	5.15	5.34
a 76	5.27	5.78	6.59	6.60	6.43	7.33	7.45	7.29	6.79	6.32	6.30	7.09	6.61
a 77	6.59	5.19	3.94	4.94	5.25	6.09	6.30	6.22	5.94	5.83	5.94	5.67	5.66
a 78	5.53	4.67	4.86	6.21	6.43	6.49	6.57	6.49	6.12	5.89	5.55	5.25	5.84
a 79	4.81	4.18	4.90	5.49	5.43	5.71	5.78	5.58	5.36	5.03	4.72	4.89	5.16
*a*1880	5.13	4.74	5.20	5.40	5.64	6.04	5.96	6.05	5.77	5.39	5.21	5.82	5.53
a 81	4.21	4.72	4.76	5.41	5.81	6.12	6.09	5.98	5.82	5.58	5.70	5.77	5.50
a 82	6.01	6.69	6.23	6.31	6.79	6.62	7.18	7.18	6.51	6.16	5.87	6.31	6.40
a 83	5.89	5.67	5.09	5.69	6.14	6.88	7.51	7.44	6.95	6.54	6.09	6.00	6.32
a 84	4.54	5.05	6.45	6.73	6.96	7.14	7.15	6.87	6.48	6.22	5.84	5.96	6.28
a 85	6.43	5.69	6.56	6.62	6.53	6.91	6.78	6.90	6.72	6.36	6.31	6.23	6.50
a 86	5.36	4.53	5.34	6.04	6.79	6.85	6.82	6.71	6.53	6.33	5.98	6.19	6.12
a 87	5.85	6.02	6.05	6.29	6.57	6.67	6.63	6.46	6.15	5.78	5.35	5.25	6.09
a 88	5.28	5.12	4.86	5.55	5.63	5.85	6.10	6.01	5.74	5.42	5.28	5.11	5.50
a 89	5.32	4.44	4.38	4.72	5.16	5.72	5.82	5.68	5.45	5.02	4.73	4.60	5.09
*a*1890	5.05	4.96	4.96	5.39	5.71	6.15	6.04	5.81	5.54	5.28	5.24	5.03	5.43
a 91	4.58	4.74	4.56	4.97	4.98	5.10	5.13	5.03	4.87	4.51	4.26	4.28	4.75
a 92	3.87	3.18	3.40	4.27	4.87	5.50	5.66	5.49	5.35	4.86	4.46	4.18	4.59
a 93	3.31	3.47	4.34	4.81	5.28	5.63	5.63	5.46	5.17	4.87	4.58	4.62	4.76
a 94	4.60	4.16	4.56	4.75	5.26	5.50	5.50	5.31	5.13	4.83	4.58	4.46	4.89
a 95	4.89	4.96	4.39	3.93	4.29	4.44	4.46	4.43	4.28	3.84	3.54	3.76	4.27
a 96	3.78	3.00	3.27	3.83	4.14	4.51	4.64	4.81	4.46	4.32	3.85	3.77	4.03
97	4.28	4.64	4.57	4.75	5.20	5.11	5.22	5.15	4.93	4.58	4.47	4.29	4.77
98	4.20	*a* 3.77	4.76	5.01	5.11	5.26	5.30	5.10	4.90	4.64	4.65	4.68	4.78
99	4.65	4.57	3.59	4.32	4.88	5.18	5.30	5.22	4.93	4.65	4.49	4.10	4.66
1900	4.03	4.24	4.67	4.64	4.79	4.99	5.01	5.06	4.89	4.74	4.52	4.41	4.67
01	4.01	3.06	3.32	2.69	3.94	4.81	5.04	5.07	4.89	4.56	4.30	4.47	4.18
02	3.31	2.96	3.96	4.22	*a* 4.50	*a* 4.88	5.50	5.41	5.08	4.92	4.62	4.64	4.50
03	4.69	4.40	4.75	5.31	5.27	5.38	5.44	5.36	5.29	5.04	4.54	4.94	5.03
04	3.74	3.92	4.92	5.64	5.61	5.92	5.97	5.82	5.60	5.31	4.94	4.89	5.19
05	3.78	3.50	3.87	4.73	5.11	5.66	5.80	5.74	5.52	5.18	4.84	4.73	4.87
06	4.86	3.99	4.00	4.88	5.20	5.42	5.58	5.54	5.30	5.08	4.99	4.89	4.98
07	4.94	4.65	4.60	5.24	5.44	5.78	5.90	5.76	5.51	5.40	5.05	4.96	5.27
Mean	574.91	574.52	574.87	575.38	575.69	575.98	576.05	575.97	575.71	575.43	575.16	575.17	575.40

Authority, U.S. Lake Survey, except for supplied values.

a.—Supplied by applying to the St. Clair Flats readings, the mean monthly fall from St. Clair Flats to Windmill Point, as deduced from observations taken between the years 1897 and 1907, inclusive.

NOTE.—Elevations depend on P.B.M., 12, 584.22 ft., U.S. Lake Survey, 1903 Levels.

TABLE 9.

WATER LEVELS OF DETROIT RIVER.

Monthly mean elevations of water surface of Detroit River, at Amherstburg, Ont., in feet above mean tide at New York.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
*a*1860	573.48	573.12	573.54	574.19	574.49	574.45	574.20	574.08	573.68	573.37	573.13	573.11	573.74
a 61	2.83	2.55	3.01	4.00	4.52	4.58	4.34	4.42	4.18	3.94	3.79	3.68	3.82
a 62	3.65	3.36	3.52	4.37	4.70	4.69	4.67	4.33	3.96	3.57	3.10	3.25	3.93
a 63	3.68	3.97	3.93	4.00	4.27	4.12	4.01	3.97	3.52	3.07	2.53	2.62	3.64
a 64	2.31	2.46	2.69	3.14	3.93	3.87	3.62	3.39	3.11	2.79	2.49	2.68	3.04
a 65	2.23	1.65	1.99	2.66	3.33	3.30	3.27	3.23	3.13	2.82	2.31	2.29	2.68
a 66	2.00	1.84	2.25	2.78	3.09	3.34	3.46	3.25	3.13	3.11	2.74	2.87	2.82
a 67	2.56	2.24	2.66	2.93	3.54	3.84	3.66	3.39	2.94	2.59	1.96	1.86	2.85
a 68	1.64	1.26	1.87	2.65	3.19	3.57	3.55	3.07	2.74	2.28	1.99	1.90	2.48
a 69	1.87	1.80	2.30	2.55	3.19	3.57	3.86	3.80	3.47	3.01	2.42	2.89	2.89
*a*1870	3.11	3.34	3.13	3.73	4.03	3.99	4.04	4.03	3.72	3.33	2.90	2.90	3.52
a 71	2.67	2.34	2.81	3.24	3.60	3.62	3.61	3.44	3.21	2.53	2.22	1.90	2.93
a 72	1.80	1.56	1.49	1.64	2.17	2.53	2.53	2.54	2.25	2.07	1.61	1.50	1.97
a 73	1.38	1.39	1.48	2.71	3.47	3.54	3.53	3.51	3.05	2.74	2.41	2.90	2.68
a 74	3.27	3.32	3.37	3.49	3.67	3.73	3.77	3.65	3.13	2.68	2.13	2.04	3.19
a 75	1.79	1.62	1.78	2.13	2.69	3.11	3.25	3.28	3.08	2.58	2.30	2.64	2.52
a 76	2.58	3.14	3.81	4.28	4.69	4.79	4.69	4.43	4.20	3.66	3.61	3.39	3.94
a 77	2.97	2.81	2.60	2.98	3.32	3.39	3.64	3.54	3.40	2.99	2.78	2.98	3.12
a 78	3.04	3.18	3.33	3.70	4.03	4.02	4.03	3.85	3.66	3.30	2.97	3.17	3.52
a 79	2.73	2.59	2.64	2.95	3.19	3.27	3.31	3.13	2.74	2.50	1.90	2.28	2.77
*a*1880	2.76	2.80	2.96	3.07	3.43	3.53	3.63	3.43	3.14	2.69	2.48	2.26	3.02
a 81	1.83	1.94	2.28	2.93	3.42	3.65	3.61	3.33	2.92	2.86	2.55	2.88	2.85
a 82	3.33	3.33	3.80	3.97	4.26	4.40	4.34	4.24	3.91	3.45	3.00	2.61	3.72
a 83	2.50	2.71	2.92	2.99	3.54	4.23	4.44	4.42	4.05	3.72	3.21	3.36	3.51
a 84	3.01	3.27	3.48	3.98	4.34	4.41	4.20	4.08	3.59	3.25	2.64	2.69	3.58
a 85	2.49	2.28	2.16	2.93	3.75	4.25	4.22	4.27	4.05	3.95	3.70	3.77	3.49
a 86	3.77	3.04	2.87	3.70	4.09	4.18	4.17	4.01	3.70	3.46	3.04	3.07	3.59
a 87	2.83	3.26	4.06	4.06	4.33	4.34	4.12	3.84	3.55	2.95	2.55	2.69	3.55
a 88	2.49	2.22	2.34	2.92	3.26	3.38	3.54	3.48	2.98	2.60	2.53	2.53	2.86
a 89	2.53	2.37	2.23	2.53	2.80	3.22	3.43	3.16	2.71	2.28	1.88	2.26	2.62
*a*1890	2.60	2.89	3.03	3.47	3.90	4.26	3.89	3.47	3.24	3.04	2.88	2.77	3.29
a 91	2.53	2.51	2.99	2.81	2.72	2.85	2.76	2.53	2.29	1.90	1.33	1.52	2.40
a 92	1.53	1.32	1.38	1.89	2.78	3.53	3.66	3.35	2.97	2.40	1.94	1.79	2.38
a 93	1.39	1.47	1.71	2.39	3.32	3.50	3.23	2.93	2.49	2.13	1.60	1.80	2.33
a 94	2.06	1.94	1.99	2.34	2.82	3.02	3.01	2.68	2.45	2.12	1.75	1.80	2.33
a 95	1.45	1.22	1.25	1.45	1.76	1.84	1.74	1.70	1.54	1.05	0.82	1.10	1.41
a 96	1.18	1.10	1.07	1.47	1.94	2.20	2.09	2.34	1.96	1.71	1.21	1.36	1.64
a 97	1.31	1.51	1.90	2.40	2.82	2.91	2.91	2.79	2.45	1.95	1.69	1.78	2.20
a 98	1.81	2.01	2.29	2.82	3.06	3.08	2.87	2.71	2.27	2.06	1.81	1.76	2.38
99	*a* 1.89	*a* 1.68	*a* 2.07	*a* 2.32	*a* 2.72	*a* 2.83	*b* 2.76	*b* 2.59	*b* 2.14	*b* 1.98	*b* 1.85	*b* 1.40	2.19
*b*1900	1.60	1.80	2.19	2.44	2.63	2.73	2.56	2.56	2.20	2.03	1.55	1.60	2.16
b 01	1.63	1.19	1.12	1.39	1.56	2.03	2.20	2.14	2.03	1.59	1.19	1.62	1.64
b 02	1.20	0.86	1.13	1.63	2.09	2.33	2.99	3.00	2.64	2.50	2.20	1.98	2.05
b 03	1.81	1.81	2.44	3.20	3.34	3.22	3.18	2.99	2.82	2.39	1.84	1.67	2.56
b 04	1.56	1.61	2.20	3.28	3.60	3.74	3.68	3.38	3.08	2.73	2.24	2.05	2.76
b 05	1.73	1.45	1.55	2.03	2.76	3.22	3.30	3.18	2.90	2.45	2.02	2.05	2.39
b 06	2.10	2.14	2.00	2.43	2.68	2.92	3.02	2.97	2.70	2.38	2.32	2.48	2.51
07	*b* 2.91	*b* 2.66	*b* 2.47	*b* 2.94	*b* 3.17	*b* 3.63	*a* 3.59	*a* 3.35	*a* 3.03	*a* 2.94	*a* 2.53	*a* 2.41	2.97
Mean	572.32	572.25	572.46	572.91	573.33	573.52	573.50	573.36	573.04	572.70	572.33	572.37	572.84

Authority, U.S. Lake Survey, except for supplied values.

a.—Supplied by applying to the Cleveland, O., readings, the mean monthly fall between Cleveland and Amherstburg, as deduced from observations taken during the period from July, 1899, to December, 1904, inclusive.

b.—Self-registering gage.

NOTE.—Elevations depend on Gage B.M., 579.337 ft., U.S. Lake Survey, 1903 Levels.

TABLE 10.

WATER LEVELS OF LAKE ERIE.

Monthly mean elevations of water surface of Lake Erie, at Cleveland, O., in feet above mean tide at New York.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
1860	573.26	572.90	573.30	574.00	574.21	574.18	573.92	573.76	573.42	573.12	573.03	572.87	573.50
61	2.61	2.33	2.77	3.81	4.24	4.31	4.06	4.10	3.92	3.69	3.67	3.44	3.58
62	3.43	3.14	3.28	4.18	4.42	4.42	4.39	4.01	3.70	3.32	2.98	3.01	3.69
63	3.46	3.75	3.69	3.81	3.99	3.85	3.73	3.65	3.26	2.82	2.41	2.38	3.40
64	2.09	2.24	2.45	2.95	3.65	3.60	3.34	3.07	2.85	2.54	2.37	2.44	2.80
65	2.01	1.43	1.75	2.47	3.05	3.03	2.99	2.91	2.87	2.57	2.19	2.05	2.44
66	1.78	1.62	2.01	2.59	2.81	3.07	3.18	2.93	2.87	2.86	2.62	2.63	2.58
67	2.34	2.02	2.42	2.74	3.26	3.57	3.38	3.07	2.68	2.34	1.84	1.62	2.61
68	1.42	1.04	1.63	2.46	2.91	3.30	3.27	2.75	2.48	2.03	1.87	1.66	2.24
69	1.65	1.58	2.06	2.36	2.91	3.30	3.58	3.48	3.21	2.76	2.30	2.65	2.65
1870	2.89	3.12	2.89	3.54	3.75	3.72	3.76	3.71	3.46	3.08	2.78	2.66	3.28
71	2.45	2.12	2.57	3.05	3.32	3.35	3.33	3.12	2.95	2.28	2.10	1.66	2.69
72	1.58	1.34	1.25	1.45	1.89	2.26	2.25	2.22	1.99	1.82	1.49	1.26	1.73
73	1.16	1.17	1.24	2.52	3.19	3.27	3.25	3.19	2.79	2.49	2.29	2.66	2.44
74	3.05	3.10	3.13	3.30	3.39	3.46	3.49	3.33	2.87	2.43	2.01	1.80	2.95
75	1.57	1.40	1.54	1.94	2.41	2.84	2.97	2.96	2.82	2.33	2.18	2.40	2.28
76	2.36	2.92	3.57	4.09	4.41	4.52	4.41	4.11	3.94	3.41	3.49	3.15	3.70
77	2.75	2.59	2.36	2.79	3.04	3.12	3.36	3.22	3.14	2.74	2.66	2.74	2.88
78	2.82	2.96	3.09	3.51	3.75	3.75	3.75	3.53	3.40	3.05	2.85	2.93	3.28
79	2.51	2.37	2.40	2.76	2.91	3.00	3.03	2.81	2.48	2.25	1.78	2.04	2.53
1880	2.54	2.58	2.72	2.88	3.15	3.26	3.35	3.11	2.88	2.44	2.36	2.02	2.77
81	1.61	1.72	2.04	2.74	3.14	3.38	3.33	3.01	2.66	2.61	2.43	2.64	2.61
82	3.11	3.11	3.56	3.78	3.98	4.13	4.06	3.92	3.65	3.20	2.88	2.37	3.48
83	2.28	2.49	2.68	2.80	3.26	3.96	4.16	4.10	3.79	3.47	3.09	3.12	3.27
84	2.79	3.05	3.24	3.79	4.06	4.14	3.92	3.76	3.33	3.00	2.52	2.45	3.34
85	2.27	2.06	1.92	2.74	3.47	3.98	3.94	3.95	3.80	3.70	3.58	3.53	3.24
86	3.55	2.82	2.63	3.51	3.81	3.91	3.89	3.69	3.44	3.21	2.92	2.83	3.35
87	2.61	3.04	3.82	3.87	4.05	4.07	3.84	3.52	3.29	2.70	2.43	2.45	3.31
88	2.27	2.00	2.10	2.73	2.98	3.11	3.26	3.16	2.72	2.35	2.41	2.29	2.62
89	2.31	2.15	1.99	2.34	2.52	2.95	3.15	2.84	2.45	2.03	1.76	2.02	2.38
1890	2.38	2.67	2.79	3.28	3.62	3.99	3.61	3.15	2.98	2.79	2.76	2.53	3.05
91	2.31	2.29	2.75	2.62	2.44	2.58	2.48	2.21	2.03	1.65	1.21	1.28	2.15
92	1.31	1.10	1.14	1.70	2.50	3.26	3.38	3.03	2.71	2.15	1.82	1.55	2.14
93	1.17	1.25	1.47	2.20	3.04	3.23	2.95	2.61	2.23	1.88	1.48	1.56	2.09
94	1.84	1.72	1.75	2.15	2.54	2.75	2.73	2.36	2.19	1.87	1.63	1.56	2.09
95	1.23	1.09	1.01	1.26	1.48	1.57	1.46	1.38	1.28	0.80	0.70	0.86	1.17
96	0.96	0.88	0.83	1.28	1.66	1.93	1.81	2.02	1.70	1.46	1.09	1.12	1.40
97	1.09	1.29	1.66	2.21	2.54	2.64	2.63	2.47	2.19	1.70	1.57	1.54	1.96
98	1.59	1.79	2.05	2.63	2.78	2.81	2.59	2.39	2.01	1.81	1.69	1.52	2.14
99	1.67	1.46	1.83	2.13	2.44	2.56	2.28	2.09	1.85	1.61	1.62	1.34	1.91
1900	1.36	1.57	1.92	2.23	2.39	2.47	2.34	2.31	1.99	1.75	1.49	1.45	1.94
01	1.35	1.06	0.88	1.29	1.31	1.72	1.91	1.78	1.71	1.33	1.16	1.19	1.39
02	1.08	0.63	0.94	1.49	1.86	2.12	2.74	2.72	2.38	2.29	2.02	1.82	1.84
03	1.72	1.70	2.28	3.05	3.09	3.05	2.98	2.76	2.59	2.25	1.77	1.31	2.38
04	1.19	1.28	1.86	2.91	3.17	3.32	3.41	3.10	2.84	2.49	2.12	1.77	2.46
05	1.52	1.31	1.18	1.83	2.46	2.98	3.06	2.87	2.63	2.31	1.93	1.92	2.17
06	1.94	1.93	1.71	2.13	2.40	2.60	2.64	2.63	2.35	2.21	2.18	2.42	2.26
07	2.76	2.46	2.24	2.71	2.85	3.27	3.31	3.03	2.77	2.69	2.41	2.26	2.73
Mean	572.10	572.03	572.22	572.70	573.05	573.24	573.22	573.04	572.78	572.45	572.21	572.14	572.60

Authority, U.S. Lake Survey.

From January, 1860, to December, 1903, inclusive, data from U.S. Lake Survey Report for 1904, page 4097.

Readings from 1904 to 1907, inclusive, from U.S. Lake Survey Annual Reports.

NOTE.—Elevations depend on B.M. "1" 581.41 ft., U.S. Lake Survey, 1903 Levels.

TABLE 11.

WATER LEVELS OF LAKE ERIE.

Monthly mean elevations of water surface of Lake Erie, at Buffalo Breakwater Light-house, in feet above mean tide at New York.

YEAR	JAN.	FEB.	MAR	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
*a*1860	573.51	572.93	573.28	573.91	574.11	574.15	573.96	573.72	573.44	573.20	573.22	573.25	573.56
a 61	2.86	2.36	2.75	3.72	4.14	4.28	4.10	4.06	3.94	3.77	3.86	3.82	3.64
a 62	3.68	3.17	3.26	4.09	4.32	4.39	4.43	3.97	3.72	3.40	3.17	3.39	3.75
a 63	3.71	3.78	3.67	3.72	3.89	3.82	3.77	3.61	3.28	2.90	2.60	2.76	3.46
a 64	2.34	2.27	2.43	2.84	3.55	3.57	3.38	3.03	2.87	2.62	2.56	2.82	2.86
a 65	2.26	1.46	1.73	2.38	2.95	3.00	3.03	2.87	2.89	2.65	2.38	2.43	2.50
a 66	2.03	1.65	1.99	2.50	2.71	3.04	3.22	2.89	2.89	2.94	2.81	3.01	2.64
a 67	2.59	2.05	2.40	2.65	3.16	3.54	3.42	3.03	2.70	2.42	2.03	2.00	2.67
a 68	1.67	1.07	1.61	2.37	2.81	3.27	3.31	2.71	2.50	2.11	2.06	2.04	2.29
a 69	1.90	1.61	2.04	2.27	2.81	3.27	3.62	3.44	3.23	2.84	2.49	3.03	2.71
*a*1870	3.14	3.15	2.87	3.45	3.65	3.69	3.80	3.67	3.48	3.16	2.97	3.04	3.34
a 71	2.70	2.15	2.55	2.96	3.22	3.32	3.37	3.08	2.97	2.36	2.29	2.04	2.75
a 72	1.83	1.37	1.23	1.36	1.79	2.23	2.29	2.18	2.01	1.90	1.68	1.64	1.79
a 73	1.41	1.20	1.22	2.43	3.09	3.24	3.29	3.15	2.81	2.57	2.48	3.04	2.49
a 74	3.30	3.13	3.11	3.21	3.29	3.43	3.53	3.29	2.89	2.51	2.20	2.18	3.01
a 75	1.82	1.43	1.52	1.85	2.31	2.81	3.01	2.92	2.84	2.41	2.37	2.78	2.34
a 76	2.61	2.95	3.55	4.00	4.31	4.49	4.45	4.07	3.96	3.49	3.68	3.53	3.76
a 77	3.00	2.62	2.34	2.70	2.94	3.09	3.40	3.18	3.16	2.82	2.85	3.12	2.94
a 78	3.07	2.99	3.07	3.42	3.65	3.72	3.79	3.49	3.42	3.13	3.04	3.31	3.34
a 79	2.76	2.40	2.38	2.67	2.81	2.97	3.07	2.77	2.50	2.33	1.97	2.42	2.59
*a*1880	2.79	2.61	2.70	2.79	3.05	3.23	3.39	3.07	2.90	2.52	2.55	2.40	2.83
a 81	1.86	1.75	2.02	2.65	3.04	3.35	3.37	2.97	2.68	2.69	2.62	3.02	2.67
a 82	3.36	3.14	3.54	3.69	3.88	4.10	4.10	3.88	3.67	3.28	3.07	2.75	3.54
a 83	2.53	2.52	2.66	2.71	3.16	3.93	4.20	4.06	3.81	3.55	3.28	3.50	3.33
a 84	3.04	3.08	3.22	3.70	3.96	4.11	3.96	3.72	3.35	3.08	2.71	2.83	3.40
a 85	2.52	2.09	1.90	2.65	3.37	3.95	3.98	3.91	3.82	3.78	3.77	3.91	3.30
a 86	3.80	2.85	2.61	3.42	3.71	3.88	3.93	3.65	3.46	3.29	3.11	3.21	3.41
87	*a* 2.86	*a* 3.07	3.75	3.71	3.93	4.07	3.91	3.51	3.20	3.26	2.71	2.89	3.41
b 88	2.57	1.96	2.03	2.69	2.84	3.01	3.23	3.12	2.78	2.59	2.44	2.74	2.67
b 89	2.56	2.34	1.95	2.33	2.49	2.96	3.00	2.91	2.53	2.03	2.03	2.34	2.46
*b*1890	2.93	2.74	2.98	3.23	3.59	3.92	3.64	3.17	2.82	2.81	3.00	2.74	3.13
b 91	2.48	2.36	2.50	2.62	2.40	2.38	2.56	2.27	2.10	1.73	1.67	1.70	2.23
b 92	1.61	0.92	1.12	1.96	2.40	3.21	3.42	3.05	2.78	2.45	2.07	2.04	2.25
b 93	1.27	1.22	1.53	2.19	2.91	3.26	3.13	2.54	2.29	2.19	2.17	2.13	2.24
b 94	2.13	1.75	1.86	2.05	2.55	2.94	2.81	2.34	2.17	2.17	1.99	1.82	2.22
b 95	1.69	1.00	0.92	1.13	1.48	1.58	1.56	1.42	1.44	1.20	0.71	0.97	1.26
b 96	1.12	1.05	0.69	1.22	1.67	1.68	1.86	2.09	1.67	1.41	1.44	1.23	1.43
b 97	1.59	1.15	1.66	2.18	2.60	2.59	2.57	2.45	2.09	1.65	1.69	1.81	2.00
b 98	1.68	1.57	1.95	2.55	2.68	2.72	2.50	2.46	2.08	1.91	2.01	2.07	2.18
99	2.05	2.59	*c* 1.85	*c* 2.04	*c* 2.32	*c* 2.51	*c* 2.45	*c* 2.09	*c* 1.90	*c* 1.48	*c* 1.55	*c* 1.96	1.98
*c*1900	1.67	1.61	1.82	2.16	2.33	2.41	2.43	2.31	2.07	1.68	1.84	1.77	2.01
c 01	*a* 1.60	*a* 1.03	0.82	1.05	1.17	1.69	1.88	1.70	1.75	1.53	1.39	1.37	1.42
c 02	1.41	0.79	0.95	1.50	1.74	2.05	2.73	2.64	2.30	2.39	2.14	*a* 2.20	1.90
c 03	1.99	1.70	2.13	2.83	2.85	2.95	2.99	2.64	2.55	2.36	2.01	2.02	2.42
c 04	1.06	1.30	1.86	2.89	3.23	3.49	3.41	3.12	2.84	2.61	2.31	2.13	2.52
c 05	1.74	1.23	1.32	1.79	2.38	2.97	3.28	3.06	2.86	2.65	2.29	2.45	2.34
c 06	2.33	1.88	1.66	2.06	2.27	2.49	2.56	2.51	2.27	2.25	2.32	2.45	2.25
c 07	2.96	2.47	2.22	2.62	2.84	3.18	3.33	3.02	2.80	2.79	2.71	2.63	2.80
Mean	572.36	572.05	572.19	572.64	572.97	573.21	573.26	573.02	572.80	572.56	572.42	572.52	572.67

Authority, U.S. Lake Survey, except for supplied values.

a.—Supplied by applying to the Cleveland, O., readings, the mean monthly rise or fall between Cleveland, O., and Buffalo, N.Y., from June, 1899, to December, 1906, inclusive.

b.—Derived from U.S. Lake Survey tables by subtracting 0.1 foot from records there given.

c.—Self-registering gage.

NOTE.—Elevations depend on B.M. "Lighthouse," 590.101 ft., U.S. Lake Survey, 1903 Levels.

TABLE 12.

WATER LEVELS OF LAKE ONTARIO.

Monthly mean elevations of water surface of Lake Ontario, at Charlotte, N.Y., in feet above mean tide at New York.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
1860	246.58	246.41	246.52	246.54	246.78	246.97	247.09	247.08	246.67	246.41	246.49	246.50	246.67
61	6.28	6.29	6.73	7.27	8.04	8.28	8.29	8.00	7.54	7.69	7.60	7.40	7.45
62	7.04	6.78	6.89	7.75	8.58	8.43	8.32	7.99	7.46	6.96	6.59	6.45	7.44
63	6.52	6.71	6.88	7.47	7.97	7.97	7.73	7.42	6.87	6.44	6.25	6.26	7.04
64	6.10	6.08	6.15	6.69	7.74	8.07	7.67	7.29	6.76	6.47	6.56	6.78	6.86
65	6.51	6.17	6.58	7.21	7.47	7.44	7.24	6.75	6.39	6.04	5.72	5.64	6.60
66	5.45	5.22	5.53	5.88	6.34	7.08	6.85	6.63	6.49	6.37	6.39	6.85	6.26
67	6.79	6.77	6.90	7.31	8.10	8.40	8.08	8.09	7.89	7.35	5.56	5.34	7.21
68	5.16	4.80	5.16	5.82	6.35	6.70	6.57	6.36	6.13	5.43	5.54	5.52	5.79
69	5.38	5.51	5.70	6.44	7.03	7.20	7.47	7.42	7.27	6.97	6.56	6.71	6.64
1870	7.24	7.39	7.32	8.35	9.03	8.81	8.54	8.09	7.49	7.14	6.72	6.52	7.72
71	6.30	6.08	6.37	7.03	7.32	7.25	7.08	6.64	6.30	5.73	5.35	4.78	6.35
72	4.63	4.43	4.30	4.72	4.96	5.28	5.34	5.19	4.94	4.84	4.73	4.54	4 82
73	4.47	4.38	4.55	6.23	6.91	6.96	6.90	6.66	6.22	5.86	5.70	5.83	5.89
74	6.30	6.64	7.08	7.19	7.32	7.28	7.39	7.14	6.64	6.03	5.50	5.20	6.64
75	4.85	4.52	4.68	5.46	5.81	5.86	6.01	5.83	5.60	5.35	5.17	5.07	5.35
76	5.48	6.11	6.70	7.62	8.30	8.42	8.44	8.02	7.35	7.00	6.66	6.39	7.21
77	5.98	5.74	5.85	6.46	6.60	6.41	6.54	6.27	5.86	5.46	5.32	5.46	6.00
78	5.60	5.83	6.34	6.74	7.06	7.05	7.08	6.97	6.82	6.38	6.35	7.03	6.60
79	6.80	6.45	6.47	6.73	6.88	6.91	6.72	6.34	5.94	5.50	5.10	5.12	6.25
1880	5.34	5.63	5.95	6.18	6.38	6.52	6.53	6.16	5.85	5.37	5.27	5.07	5.85
81	4.76	4.85	5.42	5.79	6.09	6.29	6.33	6.00	5.56	5.24	5.24	5.22	5.57
82	5.74	5.94	6.51	6.82	7.09	7.59	7.59	7.22	6.83	6.35	5.86	5.56	6.59
83	5.32	5.39	5.60	6.16	6.76	7.39	7.85	7.70	7.26	6.84	6.59	6.49	6.61
84	6.44	6.85	7.35	8.03	8.16	8.05	7.91	7.65	7.15	6.75	6.22	6.09	7.22
85	6.06	5.78	5.54	6.28	7.07	7.40	7.55	7.36	7.17	6.97	7.00	7.18	6.78
86	7.55	7.56	7.58	8.36	8.59	8.34	7.95	7.50	7.09	6.72	6.43	6.36	7.50
87	6.15	6.84	7.27	7.56	8.08	8.07	7.78	7.29	6.69	6.21	5.72	5.57	6.94
88	5.45	5.26	5.48	5.98	6.19	6.24	6.18	6.01	5.78	5.43	5.31	5.28	5.72
89	5.39	5.69	5.76	5.93	6.18	6.62	6.76	6.52	5.97	5.66	5.33	5.55	5.94
1890	6.16	6.47	6.78	6.99	7.38	7.96	7.89	7.32	6.85	6.62	6.57	6.34	6.94
91	6.02	6.10	6.65	7.27	7.19	6.78	6.47	6.10	5.68	5.04	4.34	4.36	6.00
92	4.57	4.51	4.50	4.90	5.15	5.73	6.25	6.17	5.90	5.48	5.16	5.07	5.28
93	5.06	4.73	5.11	5.81	7.04	7.31	7.09	6.49	6.21	5.77	5.27	5.09	5.92
94	5.43	5.65	6.02	6.09	6.26	6.73	6.52	5.95	5.44	5.15	4.87	4.54	5.72
95	4.55	4.39	4.40	4.74	4.96	4.79	4.53	4.26	4.04	3.64	3.41	3.51	4.27
96	3.77	4.06	4.28	5.15	5.44	5.35	5.13	4.89	4.51	4.29	4.03	3.98	4.57
97	3.84	3.85	4.30	4.96	5.52	5.69	5.63	5.63	5.17	4.58	4.38	4.47	4.84
98	4.70	5.09	5.48	5.90	6.12	6.16	5.88	5.47	5.11	4.83	4.78	4.74	5.36
99	4.88	4.78	5.07	5.61	6.01	6.15	5.95	5.56	5.04	4.71	4.59	4.39	5.23
1900	4.53	4.64	5.08	5.67	6.02	6.00	5.86	5.61	5.17	4 85	4.63	4.87	5.24
01	4.82	4.75	4.50	5.51	5.95	6.07	5 89	5.53	5.21	4.76	4.35	4 35	5 14
02	4.53	4.47	5.03	5.56	5.65	5.67	6.09	6.22	5.81	5.54	5.18	4.96	5.39
03	4.98	5.09	5.68	6.65	6.69	6.60	6.67	6.48	6.20	5.80	5.44	*a* 5 09	5.95
a 04	4.87	5.05	5.65	6 95	7.63	7.98	8.05	7.79	7.37	6.95	6.32	5.95	6 71
a 05	5.93	5.59	5.55	6.10	6.33	6.74	7.10	7.08	6.91	6.57	6.22	6.09	6.35
06	*a* 6.36	*a* 6.36	*a* 6.14	*a* 6 35	*a* 6.51	*a* 6.60	*a* 6.75	*a* 6 45	*a* 6.03	5 84	5.79	5.91	6.26
07	6.43	6.66	6.62	6.96	7.21	7.27	7.30	7.02	6.68	6.54			
Mean	245.61	245.63	245.88	246.44	246.84	246.98	246.93	246.66	246.28	245.92	245 62	245 56	

Authority, U.S. Lake Survey.

a.—From self-registering gage.

NOTE.—Elevations depend on B.M. "I" 283.168 ft., U.S. Lake Survey, 1903 Levels.

TABLE 13.

WATER LEVELS OF LAKE ONTARIO.

Monthly mean elevations of water surface of Lake Ontario, at Oswego, N.Y., in feet above mean tide at New York.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
1860	246.58	246.72	246.77	246.80	247.03	247.57	247.82	247.26	246.86	246.67	246.75	246.73	246.96
61	6.44	6.56	7.01	7.23	8.18	8.54	8.32	8.07	7.60	7.81	7.82	7.61	7.60
62	7.11	6.69	7.18	8.08	8.88	8.62	8.72	8.26	7.61	7.08	6.73	6.62	7.63
63	6.77	6.83	6.91	7.63	8.03	8.18	7.77	7.31	6.93	6.74	6.56	6.57	7.19
64	6.33	6.17	6.26	6.83	7.82	8.12	7.80	7.34	6.81	6.58	6.55	6.65	6.94
65	7.08	7.23	7.38	7.46	7.62	7.66	7.51	6.90	6.29	6.07	5.82	5.66	6.89
66	5.46	5.47	5.48	5.96	6.02	5.92	6.84	6.74	6.65	6.52	6.28	6.20	6.13
67	5.95	5.92	6.62	7.52	8.21	8.48	8.11	7.48	6.98	6.33	5.59	4.83	6.84
68	4.51	4.61	4.88	5.52	6.12	6.54	6.42	6.13	5.94	5.35	5.20	5.37	5.55
69	5.22	5.34	5.56	6.09	6.75	6.97	7.29	7.35	7.17	7.08	6.68	6.85	6.53
1870	7.26	7.41	7.41	8.35	8.95	8.63	8.31	7.97	7.28	6.95	6.38	6.13	7.59
71	6.06	5.89	6.10	6.70	7.12	7.06	6.90	6.46	6.12	5.62	5.21	4.99	6.18
72	4.73	4.51	4.35	4.84	4.96	5.29	5.35	5.19	4.90	4.74	4.69	4.35	4.82
73	4.31	4.38	4.50	6.46	7.00	6.92	6.88	6.60	6.18	5.73	5.60	5.79	5.86
74	6.35	6.75	7.30	7.19	7.17	7.26	7.21	6.98	6.34	5.94	5.37	5.03	6.57
75	4.73	4.38	4.64	5.44	5.71	5.87	5.90	5.76	5.55	5.27	5.08	4.90	5.27
76	5.31	5.97	6.52	7.50	8.08	8.30	8.37	7.91	7.30	6.96	6.60	6.42	7.10
77	5.89	5.62	5.77	6.46	6.53	6.43	6.47	6.20	5.77	5.34	5.25	5.38	5.93
78	5.48	5.69	6.39	6.64	6.98	6.97	6.93	6.85	6.59	6.33	6.21	7.02	6.51
79	6.81	6.45	6.30	6.71	6.80	6.83	6.67	6.32	5.90	5.46	5.07	5.10	6.20
1880	5.32	5.60	5.94	6.12	6.27	6.51	6.52	6.09	5.72	5.31	5.27	5.10	5.81
81	4.74	4.73	5.39	5.81	5.99	6.21	6.28	5.96	5.40	5.18	5.10	5.18	5.50
82	5.73	5.90	6.50	6.83	7.02	7.53	7.52	7.19	6.81	6.30	5.88	5.59	6.57
83	5.32	5.38	5.62	6.14	6.79	7.49	8.02	7.84	7.36	6.92	6.69	6.55	6.68
84	6.51	6.88	7.56	8.17	8.19	8.09	7.88	7.65	7.22	6.80	6.30	6.15	7.28
85	6.14	5.87	5.59	6.27	7.07	7.44	7.58	7.43	7.21	7.02	7.07	7.24	6.83
86	7.69	7.67	7.81	8.43	8.64	8.44	8.04	7.60	7.24	6.95	5.51	6.42	7.61
87	6.17	6.92	7.43	7.64	8.20	8.16	7.88	7.37	6.76	6.37	6.02	5.75	7.06
88	5.44	5.30	5.54	6.17	6.24	6.28	6.34	6.24	5.85	5.49	5.42	5.41	5.81
89	5.62	5.76	5.93	6.17	6.32	6.63	6.82	6.57	6.01	5.57	5.17	5.74	6.03
1890	6.25	6.60	6.93	7.17	7.53	8.16	7.99	7.32	6.97	6.64	6.72	6.51	7.07
91	6.19	6.45	6.99	7.47	7.25	6.83	6.55	6.11	5.68	5.04	4.44	4.41	6.12
92	4.51	4.48	4.61	5.19	5.25	5.81	6.32	6.24	6.04	5.60	5.33	5.20	5.38
93	4.87	4.76	5.24	5.99	7.15	7.37	7.11	6.57	6.30	5.78	5.37	5.22	5.98
94	5.56	5.74	6.04	6.09	6.27	6.80	6.60	6.02	5.51	5.26	4.93	4.58	5.78
95	4.49	4.43	4.33	4.88	5.00	4.88	4.59	4.34	4.00	3.66	3.41	3.44	4.29
96	3.80	4.26	4.49	5.41	5.43	5.35	5.08	4.94	4.46	4.23	3.97	3.97	4.62
97	3.88	3.82	4.32	4.96	5.40	5.61	5.61	5.60	5.10	4.47	4.41	4.47	4.80
98	4.64	5.08	5.48	5.92	6.08	6.13	5.85	5.50	5.09	4.84	4.89	4.90	5.37
99	4.98	4.88	5.13	5.69	5.94	6.07	5.92	5.46	*a* 4.95	*a* 4.55	*a* 4.42	*a* 4.36	5.20
*a*1900	4.63	4.88	5.19	5.80	5.99	5.91	5.82	5.54	5.12	4.72	4.55	4.84	5.25
a 01	4.68	4.62	4.39	5.63	5.91	5.99	5.74	5.42	5.10	4.65	4.28	4.36	5.06
a 02	4.42	4.30	4.95	5.40	5.47	5.55	5.97	6.11	5.66	5.42	5.05	4.89	5.27
a 03	4.92	5.16	5.75	6.44	6.56	6.44	6.59	6.35	6.07	5.72	5.36	5.11	5.87
04	4.72	5.00	5.63	7.00	7.61	7.87	7.89	7.64	7.25	6.87	6.36	5.81	6.64
05	5.79	5.49	5.29	6.13	6.25	6.59	6.98	6.90	6.75	6.45	6.07	5.88	6.21
06	6.13	6.09	5.91	6.25	6.38	6.41	6.57	6.26	5.81	5.48	5.58	5.74	6.05
07	6.34	6.46	6.47	6.85	7.08	7.11	7.12	6.90	6.50	6.48	6.33	6.33	6.66
Mean	245.58	245.65	245.91	246.49	246.82	246.95	246.93	246.63	246.22	245.88	245.63	245.57	246.19

Authority, U.S Lake Survey.

a.—Self-registering gage.

Floods in Oswego River during the spring may cause abnormal gage readings from 0.2 to 0.3 foot above the true mean stage of Lake Ontario.

NOTE.—Elevations depend on zero of gage, 244.12 ft., and B.M. "A," 251.90 ft., U.S. Lake Survey, 1903 Levels.

TABLE 14.

WATER LEVELS OF ST. LAWRENCE RIVER.

Monthly mean elevations of water surface of St. Lawrence River, at Ogdensburg, N.Y., in feet above mean tide at New York.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
a1860	245.65	245.78	245.83	245.86	246.07	246.58	246.82	246.29	245.91	245.73	245.81	245.79	246.01
a 61	5.52	5.63	6.05	6.26	7.16	7.50	7.29	7.05	6.61	6.81	6.82	6.62	6.61
a 62	6.15	5.75	6.21	7.06	7.82	7.57	7.67	7.23	6.62	6.12	5.79	5.69	6.64
a 63	5.83	5.88	5.96	6.64	7.02	7.16	6.77	6.34	5.98	5.80	5.63	5.64	6.22
a 64	5.41	5.26	5.35	5.88	6.82	7.10	6.80	6.37	5.87	5.65	5.62	5.72	5.99
a 65	6.12	6.26	6.40	6.48	6.63	6.67	6.53	5.95	5.38	5.17	4.93	4.78	5.94
a 66	4.59	4.60	4.61	5.06	5.12	5.03	5.89	5.80	5.72	5.59	5.37	5.29	5.22
a 67	5.06	5.03	5.69	6.54	7.19	7.44	7.09	6.50	6.03	5.41	4.72	4.00	5.89
a 68	3.70	3.79	4.05	4.65	5.22	5.61	5.50	5.23	5.05	4.49	4.35	4.51	4.68
69	a 4.37	a 4.48	a 4.69	a 5.19	a 5.81	6.18	6.41	6.41	6.16	6.08	5.70	6.04	5.63
1870	6.32	6.36	6.16	7.35	7.87	7.60	7.36	7.03	6.19	5.87	5.64	a 5.23	6.58
71	a 5.16	a 5.00	a 5.20	a 5.76	6.02	6.28	6.01	5.66	5.34	4.99	4.39	a 4.07	5.32
72	a 3.91	a 3.70	a 3.55	a 4.01	4.31	4.53	4.77	4.66	4.59	4.09	a 3.87	a 3.55	4.13
73	a 3.51	a 3.58	a 3.69	a 5.54	6.15	6.18	6.20	a 5.67	a 5.27	a 4.85	a 4.73	a 4.90	5.02
74	a 5.43	a 5.81	a 6.33	a 6.22	a 6.21	a 6.29	a 6.24	6.16	a 5.42	a 5.05	a 4.51	a 4.19	5.66
a 75	3.91	3.58	3.82	4.57	4.83	4.98	5.01	4.88	4.68	4.41	4.24	4.07	4.42
a 76	4.45	5.07	5.59	6.52	7.00	7.27	7.34	6.90	6.33	6.01	5.67	5.50	6.14
a 77	5.00	4.74	4.89	5.54	5.60	5.51	5.55	5.29	4.89	4.48	4.40	4.52	5.03
a 78	4.61	4.81	5.47	5.71	6.03	6.02	5.98	5.90	5.66	5.41	5.30	6.06	5.58
a 79	5.87	5.53	5.39	5.77	5.86	5.88	5.73	5.40	5.01	4.59	4.23	4.25	5.29
a1880	4.46	4.73	5.05	5.22	5.36	5.58	5.59	5.19	4.84	4.45	4.41	4.25	4.93
a 81	3.91	3.91	4.53	4.92	5.09	5.30	5.37	5.06	4.54	4.33	4.33	4.33	4.64
a 82	4.85	5.01	5.57	5.88	6.06	6.54	6.54	6.22	5.87	5.39	4.99	4.72	5.64
a 83	4.46	4.52	4.74	5.23	5.85	6.51	7.01	6.84	6.38	5.97	5.75	5.62	5.74
84	a 5.58	a 5.93	a 6.57	a 7.15	a 7.17	a 7.07	a 6.87	a 6.66	6.39	5.97	5.55	a 5.24	6.35
85	a 5.23	a 4.98	a 4.72	a 5.36	a 6.11	6.47	a 6.59	a 6.45	a 6.24	6.05	a 6.11	a 6.27	5.88
a 86	6.61	6.68	6.81	7.39	7.59	7.40	7.03	6.61	6.27	6.00	5.58	5.50	6.62
87	a 5.26	a 5.97	a 6.45	a 6.65	7.14	7.08	6.90	a 6.39	a 5.82	a 5.45	a 5.12	a 4.87	6.09
a 88	4.57	4.44	4.67	5.26	5.33	5.37	5.42	5.33	4.96	4.62	4.56	4.55	4.92
a 89	4.74	4.88	5.04	5.26	5.40	5.70	5.88	5.64	5.11	4.70	4.32	4.86	5.13
1890	a 5.34	a 5.67	a 5.98	a 6.21	6.59	7.00	6.97	6.12	a 6.02	a 5.71	a 5.78	a 5.58	6.08
91	a 5.28	a 5.53	a 6.04	a 6.49	a 6.28	5.72	5.49	5.07	4.71	4.29	3.99	a 3.60	5.21
92	a 3.70	a 3.67	a 3.79	a 4.34	a 4.40	a 4.92	5.26	5.15	5.21	4.67	4.36	a 4.35	4.48
a 93	4.04	3.93	4.39	5.09	6.19	6.39	6.15	5.64	5.39	4.90	4.51	4.37	5.08
a 94	4.69	4.86	5.14	5.19	5.36	5.86	5.67	5.12	4.64	4.40	4.09	3.76	4.90
a 95	3.68	3.62	3.53	4.05	4.16	4.05	3.77	3.54	3.22	2.90	2.66	2.69	3.49
a 96	3.03	3.46	3.68	4.55	4.57	4.49	4.24	4.10	3.65	3.43	3.19	3.19	3.80
a 97	3.10	3.05	3.52	4.12	4.54	4.73	4.73	4.73	4.25	3.66	3.60	3.66	3.97
a 98	3.82	4.24	4.61	5.03	5.18	5.23	4.96	4.63	4.24	4.01	4.06	4.07	4.51
a 99	4.14	4.05	4.28	4.81	5.05	5.17	5.03	4.59	4.11	3.74	3.61	3.56	4.34
1900	a 3.81	a 4.05	a 4.34	a 4.91	a 5.09	a 5.02	a 4.93	a 4.67	b 4.14	b 3.85	b 3.69	b 3.96	4.37
b 01	3.78	3.55	3.38	4.35	4.82	4.99	4.81	4.53	4.26	3.84	3.44	3.54	4.11
02	b 3.57	b 3.57	b 4.14	b 4.67	b 4.62	b 4.71	b 5.06	b 5.12	b 4.80	b 4.51	b 4.21	a 4.06	4.42
b 03	3.97	4.00	4.68	5.48	5.60	5.43	5.57	5.35	5.13	4.70	4.47	4.24	4.88
04	a 3.90	b 4.04	b 4.47	b 5.86	b 6.45	b 6.75	b 6.82	b 6.64	b 6.22	b 5.89	b 5.36	b 4.81	5.60
a 05	4.91	4.53	4.24	5.09	5.28	5.64	5.95	5.85	5.76	5.48	5.24	5.03	5.25
a 06	5.30	5.11	4.95	5.21	5.38	5.42	5.56	5.31	4.92	4.68	4.62	4.64	5.09
a 07	5.20	5.42	5.32	5.74	6.03	6.05	6.12	5.90	5.51	5.42	5.31	5.34	5.61
Mean	244.70	244.75	244.99	245.54	245.86	246.00	245.98	245.69	245.32	244.99	244.76	244.69	245.27

Authority, U.S. Lake Survey, except for supplied values.

a.—Supplied from Oswego, N.Y., readings by formula (Ogdensburg − 240) = 0.9426 (Oswego − 240) − 0.553.

b.—Self-registering gage.

NOTE.—Elevations depend on zero of gage, 244.63 ft., and B.M. "O," 247.126 ft., U.S. Lake Survey, 1903 Levels.

TABLE 15.

WATER LEVELS OF ST. LAWRENCE RIVER.

Monthly mean elevations of water surface of St. Lawrence River, at Lock No. 27, Galop Canal, head of Galop Rapids, in feet above mean tide at New York

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
*a*1860	244.08	244.22	244.26	244.29	244.80	245.31	245.55	245.02	244.64	244.46	244.54	244.22	244.62
a 61	3.95	4.07	4.49	4.70	5.89	6.23	6.02	5.79	5.34	5.54	5.55	5.06	5.22
a 62	4.59	4.19	4.65	5.50	6.55	6.31	6.40	5.97	5.35	4.85	4.52	4.12	5.25
a 63	4.26	4.32	4.40	5.08	5.75	5.89	5.50	5.07	4.71	4.53	4.36	4.08	4.83
a 64	3.85	3.70	3.78	4.32	5.55	5.83	5.53	5.10	4.60	4.38	4.35	4.15	4.60
a 65	4.56	4.70	4.84	4.92	5.36	5.40	5.26	4.68	4.10	3.90	3.66	3.21	4.55
a 66	3.03	3.04	3.04	3.50	3.85	3.75	4.62	4.53	4.44	4.32	4.09	3.73	3.83
a 67	3.49	3.46	4.12	4.97	5.92	6.17	5.82	5.23	4.76	4.14	3.44	2.43	4.50
a 68	2.93	2.22	2.48	3.08	3.94	4.34	4.22	3.95	3.77	3.21	3.07	2.94	3.35
a 69	2.80	2.91	3.12	3.62	4.54	4.75	5.05	5.11	4.94	4.85	4.47	4.34	4.21
*a*1870	4.73	4.87	4.87	5.76	6.62	6.32	6.01	5.69	5.04	4.73	4.19	3.66	5.21
a 71	3.59	3.43	3.63	4.20	4.89	4.83	4.68	4.26	3.94	3.47	3.08	2.50	3.88
a 72	2.34	2.13	1.98	2.44	2.85	3.16	3.21	3.06	2.79	2.64	2.59	1.98	2.60
a 73	1.94	2.00	2.12	3.97	4.77	4.70	4.66	4.40	4.00	3.57	3.45	3.34	3.58
a 74	3.87	4.24	4.77	4.66	4.94	5.02	4.97	4.76	4.15	3.77	3.23	2.62	4.25
75	1.45	0.46	1.77	3.24	3.61	3.80	3.79	3.62	3.53	3.15	2.81	2.77	2.83
76	2.91	3.73	4.02	5.35	5.95	6.23	6.25	5.64	4.99	4.92	4.20	3.67	4.82
77	2.37	3.17	3.57	3.80	4.51	4.38	4.56	4.05	3.51	2.90	3.00	2.99	3.57
78	2.97	3.20	4.01	4.63	5.20	*b* 4.74	4.63	4.53	4.31	3.99	3.84	4.95	4.25
79	3.39	3.75	3.81	4.36	4.44	4.54	4.50	3.86	3.45	2.86	2.94	2.90	3.73
1880	3.03	*b* 3.48	3.60	4.04	4.14	4.33	4.33	3.91	3.60	3.27	3.29	2.74	3.65
81	1.02	1.56	2.83	3.53	3.72	3.93	4.04	3.72	3.39	3.02	3.06	3.10	3.08
82	3.20	3.44	4.07	4.84	4.69	5.40	5.34	4.95	4.46	4.10	3.67	3.51	4.31
83	1.87	2.01	2.76	3.78	4.56	5.37	5.77	5.58	5.10	4.66	4.59	4.42	4.21
84	3.29	3.76	4.46	5.71	5.92	*b* 5.81	*b* 5.61	5.52	5.15	4.67	4.33	4.13	4.86
85	3.73	2.52	2.73	3.69	4.96	5.35	5.45	5.30	5.11	4.87	4.86	5.07	4.47
86	5.15	5.06	5.02	5.90	6.49	6.28	5.83	5.47	5.16	4.76	4.62	4.31	5.34
87	3.97	4.22	4.69	5.39	5.91	5.95	5.67	5.17	4.72	4.40	3.90	3.64	4.80
88	3.49	2.27	2.27	4.05	4.20	4.23	4.22	4.08	3.91	3.26	3.17	3.30	3.54
89	3.51	2.87	3.43	4.01	4.19	4.51	4.61	4.35	3.83	3.12	3.15	3.46	3.75
1890	4.10	4.13	4.64	4.98	5.26	5.89	5.74	*b* 5.09	*b* 4.79	4.38	4.32	3.44	4.73
91	3.41	3.48	4.30	5.13	4.93	4.52	4.38	3.99	3.50	2.83	2.59	2.42	3.79
92	2.33	1.83	1.98	2.97	3.16	3.59	4.21	4.03	*b* 3.87	3.44	3.09	3.10	3.11
93	2.27	1.71	2.29	3.66	4.80	5.12	4.81	4.27	4.17	3.60	3.20	3.08	3.58
94	3.16	2.44	3.49	3.82	4.04	4.61	4.40	3.81	3.37	3.15	2.95	2.39	3.47
95	2.16	1.32	1.59	2.64	2.97	2.81	2.51	2.36	2.11	1.77	1.56	1.72	2.13
96	1.80	1.93	1.86	3.06	3.46	3.29	3.17	3.02	2.54	2.32	2.22	2.04	2.56
97	1.91	1.75	2.25	3.12	3.34	3.73	3.64	3.63	3.07	2.57	2.30	2.37	2.81
98	2.44	2.52	3.58	3.21	3.54	3.59	3.32	3.24	2.85	2.58	2.56	2.61	3.00
99	2.70	2.24	2.72	3.35	3.66	3.84	3.68	3.27	2.81	2.40	2.28	2.35	2.94
1900	2.30	2.35	2.35	3.38	3.54	3.70	3.64	3.26	3.01	2.62	2.37	2.65	2.93
01	2.48	2.13	1.88	3.02	3.58	3.70	3.50	3.21	2.97	2.46	2.00	2.18	2.76
02	*c* 1.24	*c* 0.24	*c* 2.44	*c* 3.24	*c* 3.34	*c* 3.44	*c* 3.74	*c* 3.84	*c* 3.54	*b* 3.28	*c* 3.04	*c* 2.74	2.89
c 03	2.54	2.54	3.24	4.14	4.34	4.14	4.34	4.04	3.54	3.44	3.14	3.04	3.53
04	*c* 2.54	*c* 2.54	*c* 3.04	*c* 4.54	*b* 5.35	*c* 5.54	*c* 5.74	*c* 5.38	*c* 5.00	*b* 4.65	*c* 4.08	*c* 3.34	4.31
c 05	3.08	2.78	2.44	3.68	4.04	4.28	4.70	4.44	4.44	4.28	3.88	3.58	3.80
c 06	3.98	3.66	3.51	3.86	4.01	4.14	4.24	3.96	3.52	3.42	3.38	3.29	3.75
c 07	3.35	3.47	3.63	4.42	4.73	4.78	4.85	4.63	4.19	4.16	4.06	3.93	4.18
Mean	243.07	242.96	243.35	244.12	244.60	244.75	244.72	244.41	244.04	243.70	243.48	243.28	243.87

Authority, U.S. Lake Survey, except for supplied values.

a.—Supplied from Oswego readings by formula (Lock 27−240) =0.9457 (Oswego−240) −1.845 assuming a mean fall during entire period.

b.—Supplied from Oswego readings by formula (Lock 27−240) =0.9457 (Oswego−240) −1.845.

c.—Deduced from the water records of the St. Lawrence canals furnished the International Waterways Commission.

NOTE.—Elevations depend on zero of gage, sill of Lock No. 27, 234.144 ft.

TABLE 16.

WATER LEVELS OF ST. LAWRENCE RIVER.

Monthly mean elevations of water surface of St. Lawrence River, at Lock No. 24, Morrisburg Canal, head of Rapide Plat, in feet above upper sill of old lock.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
1880	8.32		8.79	9.49	9.74	9.95	9.89	9.28	8.84	8.34	8.61	7.85	9.01
81	5.69	6.74	7.94	8.77	9.02	9.36	9.56	9.17	8.53	7.89	8.45	8.55	8.31
82	8.54	8.59	9.55			10.77	10.53	10.22	9.89	9.46	8.62	8.52	9.47
83	7.57	5.90	7.65	9.14	9.93	10.78	11.15	11.05	11.06	10.12	9.83	9.58	9.48
84	7.49	8.15	12.41	10.90	11.78	11.61	11.31	11.15	10.85	9.83	9.20	8.64	10.28
85	7.90	7.18	7.55	8.51	10.21	10.61	10.74	10.58	10.09	10.05	9.94	10.39	9.48
86	10.18	10.09	10.32	11.58	11.84	11.71	11.22	10.62	10.40	10.03	9.86	9.69	10.63
87	8.77	10.40	11.13	11.13	11.44	11.41	11.06	10.46	10.07	9.68	8.99	8.48	10.25
88	7.79	6.55	7.50	9.38	9.87	9.83	9.46	9.39	8.97	8.43	8.41	8.36	8.66
89	8.71	8.16	7.96	9.50	9.48	9.92	10.05	9.79	9.13	8.32	7.95	8.77	8.98
1890	9.34	9.54	10.02	10.46		11.47	11.42	10.51	10.21	9.73	9.70	9.36	10.16
91	8.64	8.74	9.60	9.40	10.64	9.97	9.88	9.26	8.68	7.82	7.36	7.30	8.94
92	7.02	5.83	6.44	7.74	7.98	8.74	9.52	9.30	9.22	8.51	8.13	7.98	8.03
93	5.25	7.50	8.63	8.92	10.36	10.80	10.52	9.65	9.48	8.87	8.33	8.06	8.86
94	7.98	6.61	8.71	9.13	9.35	10.18	9.86	9.01	8.40	8.06	7.77	7.32	8.53
95	6.61	5.45	6.09	9.47	7.82	7.65	7.33	7.10	6.54	6.16	5.69	5.81	6.81
96	5.65	6.35	7.73	7.99	8.32	8.28	7.99	7.73	7.09	6.66	6.65	6.35	7.23
97	6.03	5.42	6.45	7.86	8.42	8.76	8.53	8.58	7.81	7.07	6.76	7.07	7.40
98	7.04	7.61	8.35	8.74	9.04	9.10	8.74	8.38	7.83	7.44	7.40	7.59	8.10
99	7.00	6.65	7.53	8.54	8.86	9.16	8.85	8.15	7.55	7.03	7.04	7.01	7.78
1900	6.91	6.89	7.16	8.50	8.88	8.93	8.84	8.32	7.90	7.40	7.12	7.59	7.87
01	7.29	7.00	7.14	8.14	8.65	9.03	8.73	8.37	8.18	7.65	7.09	7.04	7.86
a 02	7.00	5.80	7.80	8.60	8.70	8.90	9.10	9.40	8.11	8.60	8.30	7.10	8.12
a 03	8.00	7.70	8.90	9.90	9.11	9.80	9.11	9.80	9.10	8.90	8.00	7.70	8.84
a 04	6.90	7.10	7.80	9.80	10.50	10.10	11.00	10.86	10.26	10.00	9.20	8.20	9.31
a 05	7.16	10.40	9.20	9.10	9.10	9.46	9.90	9.90	9.70	9.40	9.00	8.90	9.27
a 06	9.08	8.78	8.57	9.00	9.25	9.41	9.52	9.18	8.65	8.44	8.28	8.22	8.86
a 07	8.08	8.45	9.39	10.30	10.07	10.17	10.24	10.00	10.02	9.90	9.19	9.17	9.58
Mean	7.57	7.54	8.44	9.26	9.55	9.85	9.79	9.47	9.02	8.56	8.25	8.09	8.78

Authority, U.S. Lake Survey, except for supplied values.

a.—Deduced from the water records of the St. Lawrence canals furnished the International Waterways Commission.

TABLE 17.

WATER LEVELS OF ST. LAWRENCE RIVER.

Monthly mean elevations of water surface of St. Lawrence River, at Lock No. 21, Cornwall Canal head of Long Sault Rapids, in feet above upper sill of old lock.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
1870	10.99	10.94	10.70	12.00	12.54	12.43	12.25	11.85	11.20	11.07	10.62	10.36	11.41
71	9.89	9.71	10.32	10.74	11.06	11.08	10.91	10.54	10.24	9.87	9.34	9.03	10.23
72	8.44	7.75	8.02	8.78	9.21	9.53	9.57	9.37	9.11	8.97	9.08	8.67	8.88
73	9.50	8.98	9.20	10.10	10.81	10.97	10.90	10.58	10.34	9.92	9.74	10.02	10.09
74	10.30	10.31	11.06	11.08	11.19	11.30	11 23	10.95	10.41	10.13	9.74	9.33	10.59
75	8.41	7.43	8.53	9.41	9.88	10.05	10.12	9.92	9.65	9.37	9.20	9.11	9.26
76	9.46	9.83	10.16	11.43	11.91	12.11	12.15	11.71	11.18	11.02	10.57	10.64	11.01
77	10.04	10 06	10.17	10.41	10.59	10.51	10.56	10 27	9.87	9.43	9.37	9.59	10.06
78	9.44	9.40	10 21	10.62	10.92	10.93	10 85	10.84	10.73	10.41	10.33	11.00	10.47
79	10.44	9.51	9 52	10.60	10 86	10.84	10.68	10.29	9.99	9.58	9.31	9 10	10.06
1880	9.40	9.85	9.83	10.32	10.45	10 61	10.55	10 09	9 82	9.46	9.59	9.34	9.94
81	8.18	7.18	9.02	9.77	10.01	10 25	10.29	9. 96	9.59	9.33	9.35	9.30	9 35
82	9.60	9.54	10.40	10.65	10 80	11.38	11.36	11.01		10.21	9.75	9.63	10 39
83	9.11	8.91	9 07	9.99	10 64	11.29	11.67	11.55	11.21	10.62	10.66	10 42	10.43
84	10.59	10.79	10.63	11.73	11 82	11.66	11.60	11.37	10.98	10.54	10.23	9.94	10.99
85	9 90	9.93	9.50	9.87	10.82	11.24	11.22	11 03	10.84	10.66	10.76	10.99	10 56
86	10.80	9 57	10.50	11.91	12.17	12.02	11.70	11.32	11.02	10.68	10.52	10.42	11 05
87	11.06	11.79	11.81	11.52	11.80	11.77	11.52	11.05	10.54	10.28	9.73	9.62	11 04
88	9.52	8.81	9.63	10.09	10.18	10.23	10.24	10.20	9.88	9.55	9.48	9.53	9.78
89	9.68	8.94	9.30	10.23	10.24	10.61	10.75	10.48	10.00	9.51	9 31	9.80	9.90
1890	10 24	10.23	10 72	11.07	11.42	11.83	11.76	11.21	10.94	10.53	10.62	10.39	10.91
91	10.08	9 80	10.55	11.33	11.15	10.66	10.50	10.15	9.76	9.06	8.75	8.79	10.05
92	8.66	7.67	8.37	9.29	9 30	9.86	10 40	10 18	10.14	9.73	9.46	15.52	9.88
93	14.80	15.20	15.29	16.32	10.90	11.12	10.94	10.39	10.33	9.78	9.51	9.21	11.98
94	9.32	8.18	9 73	9.99	10.15	10.66	10.44	9.94	9.55	9.26	9.04	8.62	9.57
95	8.46	6.93	7 38	8.86	8 97	8.92	8 64	8 62	8.23	7.95	7.64	7.57	8.18
96	8.26	8.68	8.54	9.28	9.42	9.38	9.19	9.02	8.54	8.19	8.22	7.99	8.73
97	7.85	7.46	8.49	9.07	9.48	9.69	9 59	9 56	9.01	8.45	8.33	8.48	8.79
98	8.48	9.59	9.51	9.66	9.82	9.84	9.64	9.37	9.03	8.65	8.67	8.77	9.25
99	8.70	8.56	9 63	9.48	9.73	9.93	9.72	9.25	8.85	8.45	8.38	8.54	9.10
1900	8.39	8.59	6.55	9.68	9.87	9.91	9.86	9.56	9.30	8.85	8.71	9.60	9.02
01	8.86	9.21	9.03	9.57	9.88	10.02	9.75	9.50	9.27	8.93	8.44	8.61	9.26
a 02	8.80	13.40	9.00	9.40	9.70	9.90	10.10	10.20	9.10	9.60	9.00	9.00	9.77
a 03	8.11	8 80	9.60	10.40	10.60	10.10	10.60	10.50	10.20	9.70	9.10	8.10	9.65
a 04	8.12	10.10	9.20	10.40	9.70	11.20	11 30	11.40	10.90	10.20	9.10	9.10	10.06
a 05	8.10	7.40	7.80	9.80	9.80	10.00	10.22	10.21	10.12	9.88	9.58	9.28	9.35
a 06	9.59	9.58	9.25	9.50	9.59	9.66	9.75	9.52	9.12	8.82	8.86	9.12	9.36
a 07	9.14	8.94	9.22	10 12	10.27	10.30	10.39	10.26	9.87	9.89	9.78	9.83	9.83
Mean	9.44	9.41	9.62	10.38	10.46	10.63	10.60	10.35	9.97	9.65	9.42	9.52	9.95

Authority, U.S. Lake Survey, except for supplied values.

a.—Deduced from the water records of the St. Lawrence canals furnished the International Waterways Commission.

TABLE 19.

DISCHARGE FROM LAKE SUPERIOR.

Monthly mean outflow from Lake Superior, through St. Marys River, in 100 cubic feet per second.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
1860	942	880	875	932	1018	1062	1062	1095	1057	1066	1025	932	994
61	875	813	780	870	1048	1087	1133	1126	1092	1098	1018	919	988
62	826	778	785	794	983	986	988	1029	1043	1027	949	875	922
63	820	785	746	750	813	799	840	986	976	937	854	817	844
64	739	686	702	702	771	810	840	845	866	806	760	714	770
65	661	654	624	721	866	965	1048	1068	1057	1009	884	801	863
66	723	670	670	769	859	907	983	1038	962	967	889	903	862
67	829	799	755	801	834	976	1062	1036	1041	1036	935	850	913
68	801	661	744	783	907	891	951	935	951	944	979	868	868
69	806	746	642	771	896	903	997	1105	1287	1168	1087	926	944
1870	856	804	806	824	932	893	946	949	974	937	893	668	874
71	744	707	644	677	808	903	944	926	937	891	840	750	814
72	693	674	619	610	815	854	946	1020	1036	1002	967	863	842
73	771	732	737	741	870	900	1002	1059	1075	1048	997	942	906
74	815	778	753	725	822	921	1006	1020	1016	1045	995	972	906
75	866	808	799	856	928	997	1016	1020	1085	1055	990	861	940
76	854	843	783	792	958	1092	1200	1211	1218	1142	1078	965	1011
77	898	905	877	850	850	900	976	1004	949	958	903	866	911
78	815	755	732	728	792	852	877	868	801	826	808	757	801
79	665	573	518	548	633	665	734	741	723	730	688	596	651
1880	550	543	522	525	695	870	926	898	935	882	889	824	755
81	753	730	734	709	806	859	905	886	930	1036	1013	937	858
82	820	769	741	730	824	845	926	949	935	914	900	838	849
83	739	718	718	734	732	817	859	956	880	845	820	760	798
84	737	693	672	633	718	741	792	801	817	838	861	801	759
85	762	737	704	665	799	877	919	969	914	873	856	787	822
86	707	670	670	665	776	813	852	884	852	859	843	744	778
87	693	661	654	622	704	808	893	866	834	875	822	728	763
88	691	612	624	622	760	956	992	990	972	969	923	778	824
89	722	664	670	668	780	816	870	872	870	840	780	704	771
1890	714	604	602	588	682	798	870	852	830	816	788	728	739
91	590	612	582	618	704	694	716	718	704	716	694	632	665
92	620	548	512	544	646	718	746	748	760	738	682	626	657
93	519	482	484	531	638	738	775	790	766	755	745	644	656
94	602	587	566	638	822	868	894	896	871	879	860	804	774
95	747	721	683	679	755	828	873	875	907	930	832	830	807
96	727	687	649	701	816	893	918	921	897	816	822	810	830
97	767	709	712	737	803	871	912	942	910	871	850	758	820
98	670	627	599	623	678	755	819	841	866	836	804	789	742
99	699	668	648	657	819	902	940	968	1004	942	926	917	841
1900	793	770	723	730	764	777	818	857	948	954	974	900	834
01	818	764	725	745	798	814	888	920	895	798	788	728	807
02	670	625	613	638	667	725	760	762	770	746	757	731	705
03	660	624	610	649	709	774	795	810	813	838	818	750	737
04	666	630	593	649	700	739	760	771	787	813	796	732	720
05	788	712	670	747	801	834	899	923	958	965	923	884	842
06	821	760	720	733	792	843	880	873	873	855	823	779	813
07	718	683	666	712	734	810	849	880	917	919	891	803	798
Mean	745	701	680	703	798	857	908	927	928	913	875	804	820

TABLE 20.

DISCHARGE FROM LAKE MICHIGAN-HURON.

Monthly mean outflow from Lake Michigan-Huron, through Detroit River, in 100 cubic feet per second.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
1860	2125	1447	1942	2051	2214	2326	2002	1995	1894	2376	1935	2250	2046
61	*a*2396	1723	2166	2290	2164	2274	2324	2409	2358	2299	2262	2264	2237
62	2053	1521	2024	2446	2358	2393	2370	2428	2411	2398	2362	2212	2248
63	2153	2040	1878	2122	2307	2204	2340	2336	2363	2202	2263	2187	2200
64	*a*2278	2043	2048	*a*2201	2309	2453	2376	2341	2310	2121	2162	2133	2231
65	1594	1446	1693	2092	2204	2241	2333	2340	2321	2276	2179	2087	2067
66	*a*2026	1928	1850	*a*1964	2098	2183	2268	2256	2243	2228	2295	2272	2134
67	1881	1996	1641	*a*2118	2299	2427	2381	2420	2337	2231	2154	2093	2165
68	*a*2042	1733	2179	2005	2209	2266	2211	2180	2146	2064	2016	1998	2095
69	1844	1692	1607	1976	1848	2030	2184	2211	2192	2091	2121	2133	1994
1870	*a*2021	1757	1853	2154	2212	2354	2456	2431	2373	2248	2248	2210	2193
71	2059	1679	*a*2257	2370	2429	2463	2466	2415	2319	2186	2174	2334	2263
72	1995	2032	1936	*a*1996	2100	2217	2059	2132	2126	2146	2024	2005	2064
73	1796	1924	2069	*a*1991	1997	2133	2195	2201	2202	2141	2134	2067	2071
74	1470	1053	1947	2053	1998	2106	2168	2164	2200	2185	2183	2027	1963
75	2008	2045	2093	2027	2187	2157	2218	2175	2140	2177	2158	1980	2114
76	2060	2160	*a*2188	2240	1955	2511	2627	2618	2389	2352	2300	*a*2283	2307
77	*a*2371	1947	1342	1753	1799	2251	2290	2277	2164	2232	1943	2149	2043
78	2054	1518	1566	2217	2231	2271	2316	2330	2178	2168	2088	1855	2066
79	1771	1482	1849	2062	1950	2078	2104	2052	2058	1961	1978	1956	1942
1880	1931	1709	1903	1974	1983	2176	2095	2216	2153	2089	2058	2054	2028
81	1756	1968	1891	2025	2083	2182	2178	2209	2247	2137	2288	2232	2100
82	2225	2045	2194	2182	2368	2206	2580	2615	2321	2271	2251	*a*2139	2283
83	*a*2238	2228	1856	2156	2230	2434	2754	2716	2538	2402	2307	2211	2339
84	1514	1703	2426	2428	2444	2541	2611	2489	2410	2367	2336	2384	2304
85	*a*2398	2352	*a*2364	*a*2287	2386	2445	2376	2432	2396	2217	2276	2204	2344
86	1677	1490	2008	2118	2428	2432	2418	2406	2403	2364	2298	2403	2204
87	2289	2253	1985	2133	2202	2261	2319	2316	2233	2217	2109	2016	2194
88	2090	2086	1922	2104	2036	2120	2208	2177	2186	2131	2079	1992	2094
89	2099	1701	1716	1792	1934	2100	2086	2097	2113	2020	1988	1817	1955
1890	1940	1797	1745	1823	1839	1964	2046	2066	1994	1919	1950	1875	1913
91	1718	1809	1534	1830	1865	1885	1931	1952	1943	1878	1912	1873	1844
92	1683	1425	1508	1767	1787	1864	1908	1926	1981	1905	1843	1753	1779
93	1464	1514	1851	1883	1817	1950	2047	2052	2034	1988	1990	1958	1879
94	1876	1698	1877	1867	1981	2045	2048	2051	2026	1971	1952	1882	1940
95	*a*1878	*a*1842	1988	1732	1814	1861	1898	1895	1868	1794	1722	1748	1837
96	1736	1410	1540	1681	1688	1791	1888	1898	1837	1842	1840	1683	1736
97	1925	*a*1784	1907	1849	1950	1871	1931	1932	1926	1898	1916	1807	1891
98	1756	1482	1888	1848	1818	1893	1986	1931	1964	1896	1969	1996	1869
99	1947	*a*1856	1366	1655	1812	1935	2022	2031	2015	1923	1883	1822	1856
1900	1736	1778	1874	1780	1796	1868	1932	1957	1978	1953	1974	1911	1878
01	1719	1410	1548	1161	1706	1986	2052	2084	2025	1983	1963	1935	1798
02	1522	1464	1827	1816	1818	1936	2054	2003	1944	1905	1846	1919	1838
03	1988	1851	1837	1879	1803	1911	1958	1978	1997	1999	1910	2138	1937
04	1612	1682	*a*1825	2035	1902	2031	2083	2103	2079	2035	1992	2019	1950
05	1580	1534	1676	1947	1922	2066	2118	2124	2094	2052	2004	1942	1922
06	1991	1548	1600	1905	1993	2034	2089	2082	2039	2021	1994	1895	1933
07	1779	1711	1749	1931	1962	1990	2075	2028	2047	2017	1961	1952	1934
Mean	1916	1756	1865	1996	2047	2148	2195	2197	2157	2110	2075	2043	2042

a.—St. Clair River discharge used.

TABLE 21.

DISCHARGE FROM LAKE ERIE.

Monthly mean outflow from Lake Erie, through Niagara River, in 100 cubic feet per second.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
1860	2321	2178	2265	2423	2475	2486	2436	2375	2304	2244	2248	2256	2334
61	2161	2045	2136	2375	2485	2521	2474	2436	2431	2387	2410	2401	2357
62	2365	2237	2258	2471	2531	2551	2562	2439	2375	2294	2237	2291	2384
63	2372	2390	2361	2375	2418	2400	2387	2346	2264	2172	2101	2137	2311
64	2041	2025	2061	2157	2332	2337	2288	2203	2165	2105	2091	2153	2163
65	2022	1846	1904	2050	2183	2195	2203	2165	2171	2112	2050	2061	2080
66	1971	1887	1962	2077	2125	2206	2248	2169	2169	2181	2150	2197	2112
67	2098	1975	2055	2112	2234	2330	2298	2203	2123	2058	1970	1964	2118
68	1891	1765	1878	2048	2149	2261	2270	2125	2077	1987	1976	1973	2033
69	1941	1878	1973	2025	2149	2261	2348	2204	2251	2157	2075	2203	2130
1870	2229	2231	2164	2306	2356	2368	2395	2361	2314	2234	2188	2206	2279
71	2123	1997	2088	2185	2248	2273	2285	2215	2188	2045	2029	1973	2137
72	1925	1828	1798	1825	1917	2016	2029	2005	1966	1941	1893	1885	1919
73	1835	1792	1796	2061	2217	2255	2267	2231	2150	2094	2072	2206	2081
74	2269	2227	2221	2246	2267	2301	2327	2267	2170	2079	2009	2005	2199
75	1923	1840	1860	1929	2033	2149	2197	2176	2157	2056	2047	2143	2043
76	2102	2183	2332	2446	2528	2578	2567	2465	2435	2317	2365	2327	2387
77	2196	2105	2041	2124	2181	2217	2294	2239	2234	2152	2159	2225	2181
78	2213	2195	2213	2298	2356	2375	2393	2317	2298	2227	2206	2271	2280
79	2137	2055	2051	2118	2149	2187	2213	2140	2077	2038	1956	2059	2098
1880	2146	2103	2124	2145	2207	2251	2291	2213	2172	2081	2088	2055	2156
81	1931	1908	1968	2112	2205	2281	2286	2188	2119	2121	2105	2200	2119
82	2283	2229	2330	2367	2416	2474	2474	2416	2362	2265	2213	2135	2330
83	2084	2081	2115	2126	2234	2427	2500	2462	2397	2332	2265	2320	2279
84	2206	2215	2248	2370	2436	2475	2436	2375	2281	2215	2126	2155	2295
85	2081	1984	1941	2112	2286	2434	2441	2423	2400	2390	2387	2423	2275
86	2395	2159	2103	2298	2372	2416	2428	2357	2307	2267	2222	2246	2298
87	2161	2212	2383	2372	2472	2465	2423	2322	2244	2258	2125	2170	2297
88	2094	1954	1971	2121	2157	2197	2251	2225	2142	2098	2064	2133	2117
89	2091	2041	1952	2038	2075	2186	2196	2174	2084	1970	1970	2041	2068
1890	2178	2133	2191	2251	2342	2426	2354	2237	2152	2150	2196	2133	2229
91	2072	2046	2077	2106	2054	2050	2091	2025	1986	1903	1891	1897	2016
92	1878	1733	1775	1954	2054	2246	2299	2208	2143	2066	1978	1973	2026
93	1806	1796	1861	2006	2174	2258	2224	2086	2028	2006	2001	1993	2020
94	1993	1908	1931	1974	2088	2181	2150	2040	2002	2002	1962	1923	2013
95	1896	1749	1733	1777	1850	1872	1867	1838	1842	1792	1691	1744	1804
96	1775	1760	1687	1796	1891	1893	1932	1983	1891	1836	1842	1797	1840
97	1875	1781	1888	2004	2101	2097	2093	2066	1984	1886	1895	1921	1966
98	1893	1870	1951	2088	2119	2128	2077	2068	1981	1943	1965	1978	2005
99	1974	1875	1929	1973	2036	2079	2066	1983	1941	1850	1866	1954	1961
1900	1891	1878	1923	1999	2038	2056	2061	2034	1978	1893	1927	1912	1966
01	1876	1755	1712	1760	1786	1896	1936	1897	1908	1861	1831	1827	1837
02	1836	1706	1739	1855	1906	1975	2130	2110	2031	2053	1995	2009	1945
03	1961	1897	1992	2154	2159	2184	2194	2110	2088	2045	1966	1968	2060
04	1762	1813	1931	2170	2252	2317	2296	2225	2157	2103	2033	1993	2088
05	1906	1797	1816	1917	2049	2188	2264	2209	2161	2112	2029	2066	2043
06	2038	1936	1889	1977	2025	2075	2091	2078	2025	2020	2036	2066	2021
07	2185	2070	2014	2105	2157	2239	2276	2200	2148	2145	2126	2108	2148
Mean	2050	1981	2012	2116	2192	2251	2263	2203	2152	2095	2063	2085	2122

Discharge values include a flow of 1000 c.f.s. through Erie Canal, and one of 1100 c.f.s. through Welland Canal.

TABLE 22.

DISCHARGE FROM LAKE ONTARIO.

Monthly mean outflow from Lake Ontario, through St. Lawrence River, in 100 cubic feet per second.

YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
1860	2629	2661	2689	2699	2883	3062	3146	2960	2827	2767	2794	2676	2816
61	2587	2615	2754	2826	3267	3390	3313	3215	3072	3141	3147	2949	3023
62	2789	2656	2808	3103	3512	3404	3454	3280	3075	2900	2788	2642	3034
63	2689	2698	2725	2956	3218	3267	3128	2977	2850	2790	2732	2619	2887
64	2544	2496	2532	2698	3146	3246	3140	2989	2814	2740	2730	2652	2811
65	2778	2826	2873	2900	3079	3093	3040	2842	2659	2584	2501	2350	2794
66	2286	2288	2297	2432	2565	2543	2822	2791	2772	2720	2655	2505	2556
67	2438	2428	2642	2929	3278	3370	3243	3030	2866	2659	2445	2111	2787
68	1699	2049	2126	2309	2695	2725	2699	2609	2552	2370	2326	2266	2361
69	2223	2257	2322	2480	2794	3076	3091	3029	2862	2845	2717	2852	2712
1870	2748	[21]2040	[21]2769	3232	3505	3441	3432	3298	2795	2681	2898	2493	2944
71	2471	2419	2483	2658	2722	3131	2921	2857	2749	2722	2361	2132	2636
72	[21]2062	[21]1873	[21]1945	2114	2448	2453	2675	2665	2768	2366	2177	1978	2294
73	1967	1992	2019	2592	3016	3121	3183	2746	2613	2486	2447	2381	2547
74	2551	[21]2632	2849	2812	2933	2960	2945	3039	2662	2551	2377	2168	2707
75	[27] 1843	[27]1579	[27]1931	2435	2428	2440	2484	2478	2320	2329	2402	2253	2244
76	2229	[21]2478	[21]2583	2931	3041	3023	3112	3164	3042	2672	2926	2748	2829
77	[27]2109	2337	[27]2452	2706	2546	2560	2424	2594	2580	2586	2433	2245	2464
78	[27]2273	[27]2342	2493	2570	2370	2875	2930	2920	2816	2792	2786	2711	2656
79	[27]2398	[21]2378	[21]2381	2550	2950	2882	2727	2884	2759	2724	2297	2346	2606
1880	2165	2424	2355	2513	2599	2696	2710	2597	2449	2276	2212	2152	2429
81	[27]1726	[21]1723	[21]2230	2598	2641	2710	2699	2605	2278	2343	2313	2281	2346
82	[27]2342	[21]2387	2553	2579	2975	2901	2970	2937	2946	2670	2566	2385	2684
83	[27]1959	[24]1872	[24]2213	2411	2827	2892	3180	3141	3001	2886	2664	2662	2642
84	[24]2184	[24]2324	[27]2724	3029	3248	3224	3153	2944	2963	2876	2657	2454	2815
85	[24]2270	[24]2121	[24]2197	2600	2771	2855	2920	2884	2792	2784	2877	2879	2662
86	[24]2787	[21]2397	[24]2693	3159	3208	3172	3140	2928	2780	2829	2399	2614	2842
87	[21]2460	[27]2650	[27]2796	3075	3212	3074	3128	2942	2624	2458	2519	2449	2782
88	2225	[24]1996	[27]2072	2555	2500	2523	2599	2615	2311	2475	2478	2366	2393
89	2408	[21]2207	[24]2283	2594	2601	2678	2819	2754	2571	2666	2228	2264	2506
1890	[24]2589	2614	[24]2748	2890	3128	3020	3155	2643	2866	2816	2956	2591	2835
91	[27]2404	[27]2425	[24]2649	3122	3033	2693	2530	2374	2382	2440	2299	2023	2531
92	[24]2089	[24]1851	[21]1974	2392	2310	2549	2400	2436	2655	2387	2323	2304	2306
93	[21]1752	[27]1915	[27]2077	2353	3040	2994	2980	2826	2608	2519	2400	2339	2484
94	2297	[21]1990	[27]2428	2673	2687	2793	2746	2600	2410	2319	2136	2206	2440
95	1989	[21]1659	[21]1774	2034	2197	2202	2134	2006	1866	1794	1710	1625	1916
96	[24]1825	1932	[27]1956	2230	2252	2306	2120	2088	1985	1924	1754	1648	2002
97	1890	[24]1783	[21]1976	2022	2321	2198	2280	2290	2215	1972	2108	2120	2098
98	[21]2074	[27]2143	2191	2580	2878	2898	2801	2501	2372	2327	2390	2069	2435
99	2078	[21]2063	2190	2289	2644	2634	2603	2434	2266	2180	2135	2034	2296
1900	2022	[24]2063	[21]1566	2365	2781	2575	2520	2530	2141	2135	2151	2226	2256
01	[27]2131	1898	1893	2364	2442	2538	2496	2414	2305	2238	2152	2133	2250
02	[27]1780	[27]1522	[27]2120	2227	2411	2434	2590	2573	2451	2337	2196	2265	2242
03	[24]1970	2049	2236	2746	2711	2681	2769	2673	2672	2289	2272	2176	2437
04	[24]1973	1969	2048	2369	2675	2888	2767	2904	2726	2640	2508	2169	2470
05	[21]1968	[21]1779	[21]1886	2211	2449	2666	2668	2778	2671	2475	2536	2220	2359
06	[21]2403	2244	2191	2518	2589	2527	2606	2551	2464	2283	2249	2339	2414
07	[21]2266	[21]2207	[21]2291	2664	2741	2720	2742	2672	2590	2509	2467	2284	2513
Mean	2236	2193	2333	2606	2795	2835	2836	2750	2621	2526	2450	2341	2544

NOTE.—21, 24, and 27 indicate that St. Lawrence River discharges were derived from gage observations taken at Locks 21, 24, and 27, respectively

TABLE 24.

SUPPLY FACTORS OF LAKE SUPERIOR.

DATE.	WATER LEVELS OF—			STORAGE IN LAKE SUPERIOR.		OUTFLOW THROUGH ST. MARYS RIVER.		TOTAL SUPPLY TO LAKE SUPERIOR.	
	Lake Superior		St. Marys River.						
	Marquette, Mich. *a*		Sault Ste. Marie, Mich.						
	First of Month.	Mean of Month.	Mean of Month.	Ft. Depth.	100 c.f.s	100c.f.s	Ft. Depth, Lake Superior.	100 c.f.s.	Ft. Depth
1860									
Jan.		602.69	602.22			942	0.277		
Feb.	602.565	2.44	1.95	−0.135	− 459	880	0.259	421	0.124
Mar.	2.43	2.42	1.93	+0.125	+ 425	875	0.257	1300	0.382
April	2.555	2.69	2.18	+0.250	+ 850	932	0.274	1782	0.524
May	2.805	2.92	2.55	+0.200	+ 680	1018	0.299	1698	0.499
June	3.005	3.09	2.74	+0.065	+ 221	1062	0.312	1283	0.377
July	3.07	3.05	2.74	+0.005	+ 17	1062	0.312	1079	0.317
Aug.	3.075	3.10	2.80	+0.015	+ 51	1075	0.316	1126	0.331
Sept.	3.09	3.08	2.72	+0.010	+ 34	1057	0.311	1091	0.321
Oct.	3.10	3.12	2.76	−0.065	− 221	1066	0.313	845	0.248
Nov.	3.035	2.95	2.58	−0.260	− 884	1025	0.301	141	0.041
Dec.	2.775	2.60	2.18	−0.275	− 935	935	0.274	− 3	−0.001
1861									
Jan.	2.50	2.40	1.93	−0.225	− 765	875	0.257	110	−0.032
Feb.	2.275	2.15	1.66	−0.195	− 663	813	0.239	150	0.044
Mar.	2.08	2.01	1.52	+0.135	+ 459	780	0.229	1239	0.364
April	2.215	2.42	1.91	+0.520	+1768	870	0.256	2638	0.776
May	2.735	3.05	2.68	+0.390	+1326	1048	0.308	2374	0.698
June	3.125	3.20	2.85	+0.155	+ 527	1087	0.320	1614	0.475
July	3.28	3.36	3.05	+0.060	+ 204	1133	0.333	1337	0.393
Aug.	3.34	3.32	3.02	−0 065	− 221	1126	0.331	905	0.266
Sept.	3.275	3.23	2.87	−0.030	− 102	1092	0.321	990	0.291
Oct.	3.245	3.26	2.90	−0 155	− 527	1098	0.323	571	0.168
Nov.	3.09	2.92	2.55	−0 360	−1224	1018	0.299	− 206	−0.061
Dec.	2.73	2.54	2.12	−0.365	−1241	919	0.270	− 322	−0.095
1862									
Jan.	2.365	2.19	1.72	−0.270	− 918	826	0.243	− 92	−0.027
Feb.	2.095	2.00	1.51	−0.080	− 272	778	0.229	506	0.149
Mar.	2.015	2.03	1.54	+0.045	+ 153	785	0.231	938	0.276
April	2.06	2.09	1.58	+0.370	+1258	794	0.233	2052	0.603
May	2.43	2.77	2.40	+0.335	+1139	983	0.289	2122	0.624
June	2.765	2.76	2.41	−0.020	− 68	986	0.290	918	0.270
July	2.745	2.73	2.42	+0.070	+ 238	988	0.290	1226	0.360
Aug.	2.815	2.90	2.60	+0.145	+ 493	1029	0.303	1522	0.448
Sept.	2.96	3.02	2.66	+0.025	+ 85	1043	0.307	1128	0.332
Oct.	2.985	2.95	2.59	−0.200	− 680	1027	0.302	347	0.102
Nov.	2.785	2.62	2.25	−0.300	−1020	949	0.279	− 71	−0.021
Dec.	2.485	2.35	1.93	−0.230	− 782	875	0.257	93	0.027
1863									
Jan.	2.255	2.16	1.69	−0.160	− 544	820	0.241	276	0.081
Feb.	2.095	2.03	1.54	−0.150	− 510	785	0.231	275	0.081
Mar.	1.945	1.86	1.37	−0.065	− 221	746	0.219	525	0.154
April	1.88	1.90	1.39	+0.085	+ 289	750	0.221	1039	0.306
May	1.965	2.03	1.66	+0.025	+ 85	813	0.239	898	0.264
June	1.99	1.95	1.60	+0.030	+ 102	799	0.235	901	0.265
July	2.02	2.09	1.78	+0.380	+1292	840	0.247	2132	0.627
Aug.	2.40	2.71	2.41	+0.320	+1088	986	0.290	2074	0.610
Sept.	2.72	2.73	2.37	−0.075	− 255	976	0.287	721	0.212
Oct.	2.645	2.56	2.20	−0.260	− 884	937	0.276	53	0.016
Nov.	2.385	2.21	1.84	−0.230	− 782	854	0.251	72	0.021
Dec.	2.155	2.10	1.68	−0.200	− 680	817	0.240	137	0.040

a.—Water Levels taken at Superior, Wis., from 1860 to 1871, inclusive.

TABLE 24.—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

DATE.	WATER LEVELS OF—			STORAGE IN LAKE SUPERIOR.		OUTFLOW THROUGH ST. MARYS RIVER.		TOTAL SUPPLY TO LAKE SUPERIOR.	
	Lake Superior		St. Marys River.						
	Marquette, Mich. *a*		Sault Ste. Marie, Mich.						
	First of Month.	Mean of Month.	Mean of Month.	Ft. Depth.	100 c.f.s	100c.f.s	Ft. Depth, Lake Superior.	100 c.f.s.	Ft. Depth
1864									
Jan.	601.955	601.81	601.34	−0.250	− 850	739	0.217	− 111	−0.033
Feb.	1.705	1.60	1.11	−0.070	− 238	686	0.202	448	0.132
Mar.	1.635	1.67	1.18	+0.045	+ 153	702	0.206	855	0.251
April	1.68	1.69	1.18	+0.090	+ 306	702	0.206	1008	0.296
May	1.77	1.85	1.48	+0.155	+ 527	771	0.227	1298	0.382
June	1.925	2.00	1.65	+0.120	+ 408	810	0.238	1218	0.358
July	2.045	2.09	1.78	+0.050	+ 170	840	0.247	1010	0.297
Aug.	2.095	2.10	1.80	+0.080	+ 272	845	0.248	1117	0.328
Sept.	2.175	2.25	1.89	−0.055	− 187	866	0.255	679	0.200
Oct.	2.12	1.99	1.63	−0.225	− 765	806	0.237	41	0.012
Nov.	1.895	1.80	1.43	−0.170	− 578	760	0.223	182	0.053
Dec.	1.725	1.65	1.23	−0.165	− 561	714	0.210	153	0.045
1865									
Jan.	1.56	1.47	1.00	−0.095	− 323	661	0.194	338	0.099
Feb.	1.465	1.46	0.97	−0.070	− 238	654	0.192	416	0.122
Mar.	1.395	1.33	0.84	+0.155	+ 527	624	0.183	1151	0.338
April	1.55	1.77	1.26	+0.465	+1582	721	0.212	2303	0.677
May	2.015	2.26	1.89	+0.450	+1530	866	0.255	2396	0.705
June	2.465	2.67	2.32	+0.365	+1241	965	0.284	2206	0.649
July	2.83	2.99	2.68	+0.200	+ 680	1048	0.308	1728	0.508
Aug.	3.03	3.07	2.77	+0.045	+ 153	1068	0.314	1221	0.359
Sept.	3.075	3.08	2.72	−0.100	− 340	1057	0.311	717	0.211
Oct.	2.975	2.87	2.51	−0.370	−1258	1009	0.297	− 249	−0.073
Nov.	2.605	2.34	1.97	−0.420	−1428	884	0.260	− 544	−0.160
Dec.	2.185	2.03	1.61	−0.300	−1020	801	0.236	− 219	−0.064
1866									
Jan.	1.885	1.74	1.27	−0.250	− 850	723	0.213	− 127	−0.037
Feb.	1.635	1.53	1.04	−0.105	− 357	670	0.197	313	0.092
Mar.	1.53	1.53	1.04	+0.225	+ 765	670	0.197	1435	0.422
April	1.755	1.98	1.47	+0.350	+1190	769	0.226	1959	0.576
May	2.105	2.23	1.86	+0.220	+ 748	859	0.253	1607	0.473
June	2.325	2.42	2.07	+0.240	+ 816	907	0.267	1723	0.507
July	2.565	2.71	2.40	+0.260	+ 884	983	0.289	1867	0.549
Aug.	2.825	2.94	2.64	−0.020	− 68	1038	0.305	970	0.285
Sept.	2.805	2.67	2.31	−0.125	− 425	962	0.283	537	0.158
Oct.	2.68	2.69	2.33	−0.155	− 527	967	0.284	440	0.129
Nov.	2.525	2.36	1.99	−0.110	− 374	889	0.261	515	0.151
Dec.	2.415	2.47	2.05	−0.080	− 272	903	0.266	631	0.186
1867									
Jan.	2.335	2.20	1.73	−0.190	− 646	829	0.244	183	0.054
Feb.	2.145	2.09	1.60	−0.150	− 510	799	0.235	289	0.085
Mar.	1.995	1.90	1.41	+0.015	+ 51	755	0.222	806	0.237
April	2.01	2.12	1.61	+0.050	+ 170	801	0.236	971	0.286
May	2.06	2.12	1.75	+0.350	+1190	834	0.245	2024	0.595
June	2.41	2.72	2.37	+0.475	+1616	976	0.287	2592	0.762
July	2.885	3.05	2.74	+0.105	+ 357	1062	0.312	1419	0.417
Aug.	2.99	2.93	2.63	−0.020	− 68	1036	0.305	968	0.285
Sept.	2.97	3.01	2.65	+0.030	+ 102	1041	0.306	1143	0.336
Oct.	3.00	2.99	2.63	−0.225	− 765	1036	0.305	271	0.080
Nov.	2.775	2.56	2.19	−0.375	−1275	935	0.275	− 340	−0.100
Dec.	2.40	2.24	1.82	−0.240	− 816	850	0.250	34	0.010

a.—Water Levels taken at Superior, Wis., from 1860 to 1871, inclusive.

TABLE 24.—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

DATE.	WATER LEVELS OF—			STORAGE IN LAKE SUPERIOR.		OUTFLOW THROUGH ST. MARYS RIVER.		TOTAL SUPPLY TO LAKE SUPERIOR.	
	Lake Superior		St. Marys River.						
	Marquette, Mich. *a*		Sault Ste. Marie, Mich.						
	First of Month.	Mean of Month.	Mean of Month.	Ft. Depth.	100 c.f.s	100c.f.s	Ft. Depth, Lake Superior.	100 c.f.s.	Ft. Depth
1868									
Jan.	602.16	602 08	601.61	−0.375	−1275	801	0.236	− 474	−0.139
Feb.	1.785	1.49	1.00	−0.115	− 391	661	0.194	270	0.079
Mar.	1.67	1.85	1.36	+0.265	+ 901	744	0.219	1645	0.484
April	1.945	2.04	1.53	+0.295	+1003	783	0.230	1786	0.525
May	2.24	2.44	2.07	+0.155	+ 527	907	0.267	1434	0.422
June	2.395	2.35	2.00	+0.065	+ 221	891	0.262	1112	0.327
July	2.46	2.57	2.26	+0.070	+ 238	951	0.280	1189	0.350
Aug.	2.53	2.49	2.19	+0.025	+ 85	935	0.275	1020	0.300
Sept.	2.555	2.62	2.26	+0.050	+ 170	951	0.280	1121	0.330
Oct.	2.605	2.59	2.23	+0.065	+ 221	944	0.278	1165	0.343
Nov.	2.67	2.75	2.39	−0.135	− 459	979	0.288	520	0.153
Dec.	2.535	2.32	1.90	−0.325	−1105	868	0.255	− 237	−0.070
1869									
Jan.	2.21	2.10	1.63	−0.230	− 782	806	0.237	24	0.007
Feb.	1.98	1.86	1.37	−0.345	−1173	746	0.219	− 427	−0.126
Mar.	1.635	1.41	0.92	+0.065	+ 221	642	0.189	863	0.254
April	1.70	1.99	1.48	+0.490	+1666	771	0.227	2436	0.716
May	2.19	2.39	2.02	+0.205	+ 697	896	0.263	1593	0.468
June	2.395	2.40	2.05	+0.190	+ 646	903	0.266	1549	0.456
July	2.585	2.77	2.46	+0.415	+1411	997	0.293	2408	0.708
Aug.	3.00	3.23	2.93	+0.655	+2228	1105	0.325	.3333	0.980
Sept.	3.655	4.08	3.72	+0.165	+ 561	1287	0.378	1848	0.543
Oct.	3.82	3.56	3.20	−0.430	−1462	1168	0.343	− 294	−0.086
Nov.	3.39	3.22	2.85	−0.495	−1684	1087	0.320	− 597	−0.176
Dec.	2.895	2.57	2.15	−0.450	−1530	926	0.272	− 604	−0.178
1870									
Jan.	2.445	2.32	1.85	−0.230	− 782	856	0.252	74	0.022
Feb.	2.215	2.11	1.62	−0.100	− 340	804	0.236	464	0.136
Mar.	2.115	2.12	1.63	+0.055	+ 187	806	0.237	993	0.292
April	2.17	2.22	1.71	+0.215	+ 731	824	0.242	1555	0.457
May	2.385	2.55	2.18	+0.070	+ 238	932	0.274	1170	0.344
June	2.455	2.36	2.01	0.000	0	893	0.263	893	0.263
July	2.455	2.55	2.24	+0.095	+ 323	946	0.278	1269	0.373
Aug.	2.55	2.55	2.25	+0.085	+ 289	949	0.279	1238	0.364
Sept.	2.635	2.72	2.36	+0.005	+ 17	974	0.286	991	0.291
Oct.	2.64	2.56	2.20	−0.170	− 578	937	0.276	359	0.106
Nov.	2.47	2.38	2.01	−0.555	−1888	893	0.263	− 995	−0.293
Dec.	1.915	1.45	1.03	−0.510	−1734	668	0.196	−1066	−0.313
1871									
Jan.	1.405	1.36	1.36	−0.345	−1173	744	0.219	− 429	−0.126
Feb.	1.06	0.76	1.20	+0.410	+1394	707	0.208	2101	0.618
Mar.	1.47	1.18	0.93	−0.040	− 136	644	0.189	508	0.149
April	1.43	1.68	1.07	+0.515	+1752	677	0.199	2429	0.714
May	1.945	2.21	1.64	+0.325	+1105	808	0.238	1913	0.562
June	2.27	2.33	2.05	+0.095	+ 323	903	0.266	1226	0.360
July	2.365	2.40	2.23	+0.065	+ 221	944	0.278	1165	0.343
Aug.	2.43	2.46	2.15	+0.080	+ 272	926	0.272	1198	0.352
Sept.	2.51	2.56	2.20	+0.015	+ 51	937	0.276	988	0.291
Oct.	2.525	2.49	2.00	−0.070	− 238	891	0.262	653	0.192
Nov.	2.455	2.42	1.78	−0.405	−1377	840	0.247	− 537	−0.158
Dec.	2.05	1.68	1.39	−0.475	−1616	750	0.221	− 866	−0.255

a.—Water Levels taken at Superior, Wis., from 1860 to 1871, inclusive.

TABLE 24.—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

DATE.	WATER LEVELS OF— Lake Superior Marquette, Mich. *a* First of Month.	Lake Superior Marquette, Mich. *a* Mean of Month.	St. Marys River. Sault Ste. Marie, Mich. Mean of Month.	STORAGE IN LAKE SUPERIOR. Ft. Depth.	STORAGE IN LAKE SUPERIOR. 100 c.f.s	OUTFLOW THROUGH ST. MARYS RIVER. 100c.f.s	OUTFLOW THROUGH ST. MARYS RIVER. Ft. Depth, Lake Superior.	TOTAL SUPPLY TO LAKE SUPERIOR. 100 c.f.s.	TOTAL SUPPLY TO LAKE SUPERIOR. Ft. Depth
1872									
Jan.	601.575	601.47	601.14	−0.160	− 544	693	0.204	149	0.044
Feb.	1.415	1.36	1.06	−0.115	− 391	674	0.198	283	0.083
Mar.	1.30	1.24	0.82	−0.110	− 374	619	0.182	245	0.072
April	1.19	1.14	0.78	+0.275	+ 935	610	0.179	1545	0.454
May	1.465	1.79	1.67	+0.515	+1752	815	0.240	2567	0.755
June	1.98	2.17	1.84	+0.325	+1105	854	0.251	1959	0.576
July	2.305	2.44	2.24	+0.220	+ 748	946	0.278	1694	0.498
Aug.	2.525	2.61	2.56	+0.165	+ 561	1020	0.300	1581	0.465
Sept.	2.69	2.77	2.63	+0.030	+ 102	1036	0.305	1138	0.335
Oct.	2.72	2.67	2.48	−0.125	− 425	1002	0.295	577	0.170
Nov.	2.595	2.52	2.33	−0.225	− 765	967	0.284	202	0.059
Dec.	2.37	2.22	1.88	−0.200	− 680	863	0.254	183	0.054
1873									
Jan.	2.17	2.12	1.48	−0.210	− 714	771	0.227	57	0.017
Feb.	1.96	1.80	1.31	−0.150	− 510	732	0.215	222	0.065
Mar.	1.81	1.82	1.33	+0.030	+ 102	737	0.217	839	0.247
April	1.84	1.86	1.35	+0.245	+ 833	741	0.218	1574	0.463
May	2.085	2.31	1.91	+0.375	+1275	870	0.256	2145	0.631
June	2.46	2.61	2.04	+0.295	+1003	900	0.265	1903	0.560
July	2.755	2.90	2.48	+0.235	+ 799	1002	0.295	1801	0.530
Aug.	2.99	3.08	2.73	+0.120	+ 408	1059	0.311	1467	0.431
Sept.	3.11	3.14	2.80	−0.020	− 68	1075	0.316	1007	0.296
Oct.	3.09	3.04	2.68	−0.120	− 408	1048	0.308	640	0.188
Nov.	2.97	2.90	2.46	−0.220	− 748	997	0.293	249	0.073
Dec.	2.75	2.60	2.22	−0.380	−1292	942	0.277	− 350	−0.103
1874									
Jan.	2.37	2.14	1.67	−0.235	− 799	815	0.240	16	0.005
Feb.	2.135	2.13	1.51	−0.025	− 85	778	0.229	693	0.204
Mar.	2.11	2.09	1.40	+0.030	+ 102	753	0.221	855	0.252
April	2.14	2.19	1.28	+0.085	+ 289	725	0.213	1014	0.298
May	2.225	2.26	1.70	+0.135	+ 459	822	0.242	1281	0.377
June	2.36	2.46	2.13	+0.290	+ 986	921	0.271	1907	0.561
July	2.65	2.84	2.50	+0.235	+ 799	1006	0.296	1805	0.531
Aug.	2.885	2.93	2.56	+0.095	+ 323	1020	0.300	1343	0.395
Sept.	2.98	3.03	2.54	+0.080	+ 272	1016	0.299	1288	0.379
Oct.	3.06	3.09	2.67	−0.060	− 204	1045	0.307	841	0.247
Nov.	3.00	2.91	2.45	−0.245	− 833	995	0.293	162	0.048
Dec.	2.755	2.60	2.35	−0.315	−1071	972	0.286	− 99	−0.029
1875									
Jan.	2.44	2.28	1.89	−0.180	− 612	866	0.255	254	0.075
Feb.	2.26	2.24	1.64	0.000	0	808	0.238	808	0.238
Mar.	2.26	2.28	1.60	+0.020	+ 68	799	0.235	867	0.255
April	2.28	2.28	1.85	+0.110	+ 374	856	0.252	1230	0.362
May	2.39	2.50	2.16	+0.290	+ 986	928	0.273	1914	0.563
June	2.68	2.86	2.46	+0.175	+ 595	997	0.293	1593	0.468
July	2.855	2.85	2.54	+0.040	+ 136	1016	0.299	1152	0.339
Aug.	2.895	2.94	2.56	+0.160	+ 544	1020	0.300	1564	0.460
Sept.	3.055	3.17	2.84	+0.040	+ 136	1085	0.319	1221	0.359
Oct.	3.095	3.02	2.71	−0.145	− 493	1055	0.310	562	0.165
Nov.	2.95	2.88	2.43	−0.170	− 578	990	0.291	412	0.121
Dec.	2.78	2.68	1.87	−0.200	− 680	861	0.253	181	0.053

TABLE 24.—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

DATE.	WATER LEVELS OF— Lake Superior Marquette, Mich. *a* First of Month.	Lake Superior Marquette, Mich. *a* Mean of Month.	St. Marys River. Sault Ste. Marie, Mich. Mean of Month.	STORAGE IN LAKE SUPERIOR. Ft. Depth.	STORAGE IN LAKE SUPERIOR. 100 c.f.s	OUTFLOW THROUGH ST. MARYS RIVER. 100c.f.s	OUTFLOW THROUGH ST. MARYS RIVER. Ft. Depth. Lake Superior.	TOTAL SUPPLY TO LAKE SUPERIOR. 100 c.f.s.	TOTAL SUPPLY TO LAKE SUPERIOR. Ft. Depth
1876									
Jan.	602.58	602.48	601.84	−0.205	− 697	854	0.251	157	0.046
Feb.	2.375	2.27	1.79	−0.150	− 510	843	0.248	333	0.098
Mar.	2.225	2.18	1.53	−0.030	− 102	783	0.230	681	0.200
April	2.195	2.21	1.57	+0.285	+ 969	792	0.233	1761	0.518
May	2.48	2.75	2.29	+0.610	+2075	958	0.282	3033	0.892
June	3.09	3.43	2.87	+0.535	+1820	1092	0.321	2912	0.856
July	3.625	3.82	3.34	+0.250	+ 850	1200	0.353	2050	0.603
Aug.	3.875	3.93	3.39	0.000	0	1211	0.356	1211	0.356
Sept.	3.875	3.82	3.42	−0.220	− 748	1218	0.358	470	0.138
Oct.	3.655	3.49	3.09	−0.245	− 833	1142	0.336	309	0.091
Nov.	3.41	3.33	2.81	−0.220	− 748	1078	0.317	330	0.097
Dec.	3.19	3.05	2.32	−0.320	−1088	965	0.284	− 123	−0.036
1877									
Jan.	2.87	2.69	2.03	−0.300	−1020	898	0.264	− 122	−0.036
Feb.	2.57	2.45	2.06	−0.250	− 850	905	0.266	55	0.016
Mar.	2.32	2.19	1.94	−0.170	− 578	877	0.258	299	0.088
April	2.15	2.11	1.82	−0.045	− 153	850	0.250	697	0.205
May	2.105	2.10	1.82	+0.105	+ 357	850	0.250	1207	0.355
June	2.21	2.32	2.04	+0.300	+1020	900	0.265	1920	0.565
July	2.51	2.70	2.37	+0.220	+ 748	976	0.287	1724	0.507
Aug.	2.73	2.76	2.49	−0.050	− 170	1004	0.295	834	0.245
Sept.	2.68	2.60	2.25	−0.080	− 272	949	0.279	677	0.199
Oct.	2.60	2.60	2.29	−0.105	− 357	958	0.282	601	0.177
Nov.	2.495	2.39	2.05	−0.140	− 476	903	0.266	427	0.126
Dec.	2.355	2.32	1.89	−0.095	− 323	866	0.255	543	0.160
1878									
Jan.	2.26	2.20	1.67	0.000	0	815	0.240	815	0.240
Feb.	2.26	2.32	1.41	−0.325	−1105	755	0.222	− 350	−0.103
Mar.	1.935	1.55	1.31	−0.400	−1360	732	0.215	− 628	−0.185
April	1.535	1.52	1.29	+0.120	+ 408	728	0.214	1136	0.334
May	1.655	1.79	1.57	+0.275	+ 935	792	0.233	1727	0.508
June	1.93	2.07	1.83	+0.175	+ 595	852	0.251	1447	0.425
July	2.105	2.14	1.94	−0.025	− 85	877	0.258	792	0.233
Aug.	2.08	2.02	1.90	−0.145	− 493	868	0.255	375	0.110
Sept.	1.935	1.85	1.61	−0.050	− 170	801	0.236	631	0.186
Oct.	1.885	1.92	1.72	−0.065	− 221	826	0.243	605	0.178
Nov.	1.82	1.72	1.64	−0.260	− 884	808	0.238	− 76	−0.022
Dec.	1.56	1.40	1.42	−0.115	− 391	757	0.223	366	0.108
1879									
Jan.	1.445	1.49	1.02	+0.030	+ 102	665	0.196	767	0.226
Feb.	1.475	1.46	0.62	+0.135	+ 459	573	0.168	1032	0.303
Mar.	1.61	1.76	0.38	−0.045	− 153	518	0.152	365	0.107
April	1.565	1.37	0.51	−0.375	−1275	548	0.161	− 727	−0.214
May	1.19	1.01	0.88	−0.065	− 221	633	0.186	412	0.121
June	1.125	1.24	1.02	+0.235	+ 799	665	0.196	1464	0.431
July	1.36	1.48	1.32	+0.180	+ 612	734	0.216	1346	0.396
Aug.	1.54	1.60	1.35	+0.005	+ 17	741	0.218	758	0.223
Sept.	1.545	1.49	1.27	−0.010	− 34	723	0.213	689	0.203
Oct.	1.535	1.58	1.30	+0.005	+ 17	730	0.215	747	0.220
Nov.	1.54	1.50	1.12	−0.220	− 748	688	0.202	− 60	−0.018
Dec.	1.32	1.14	0.72	−0.255	− 867	596	0.175	− 271	−0.080

TABLE 24.—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

DATE.	WATER LEVELS OF—			STORAGE IN LAKE SUPERIOR.		OUTFLOW THROUGH ST. MARYS RIVER.		TOTAL SUPPLY TO LAKE SUPERIOR.	
	Lake Superior		St. Marys River.						
	Marquette, Mich. *a*		Sault Ste. Marie, Mich.						
	First of Month.	Mean of Month.	Mean of Month.	Ft. Depth.	100 c.f.s	100c.f.s	Ft. Depth, Lake Superior.	100 c.f.s.	Ft. Depth
1880									
Jan.	601.065	600.99	600.52	−0.080	− 272	550	0.162	278	0.082
Feb.	0.985	0.98	0.49	−0.050	− 170	543	0.160	373	0.110
Mar.	0.935	0.89	0.40	+0.470	+1598	522	0.153	2120	0.623
April	1.405	1.92	0.41	+0.315	+1071	525	0.154	1596	0.469
May	1.72	1.52	1.15	+0.190	+ 646	695	0.204	1341	0.394
June	1.91	2.30	1.91	+0.465	+1582	870	0.256	2452	0.721
July	2.375	2.45	2.15	+0.070	+ 238	926	0.272	1164	0.342
Aug.	2.445	2.44	2.03	−0.005	− 17	898	0.264	881	0.259
Sept.	2.44	2.44	2.19	−0.025	− 85	935	0.275	850	0.250
Oct.	2.415	2.39	1.96	−0.055	− 187	882	0.259	695	0.204
Nov.	2.36	2.33	1.99	−0.160	− 544	889	0.261	345	0.101
Dec.	2.20	2.07	1.71	−0.260	− 884	824	0.242	− 60	−0.018
1881									
Jan.	1.94	1.81	1.40	−0.180	− 612	753	0.221	141	0.041
Feb.	1.76	1.71	1.30	−0.095	− 323	730	0.215	407	0.120
Mar.	1.665	1.62	1.32	−0.090	− 306	734	0.216	428	0.126
April	1.575	1.53	1.21	+0.105	+ 357	709	0.208	1066	0.313
May	1.68	1.83	1.63	+0.370	+1258	806	0.237	2064	0.607
June	2.05	2.27	1.86	+0.250	+ 850	859	0.253	1709	0.503
July	2.30	2.33	2.06	+0.055	+ 187	905	0.266	1092	0.321
Aug.	2.355	2.38	1.98	+0.140	+ 476	886	0.260	1362	0.400
Sept.	2.495	2.61	2.17	+0.285	+ 969	930	0.273	1899	0.558
Oct.	2.78	2.95	2.63	+0.135	+ 459	1036	0.305	1495	0.440
Nov.	2.915	2.88	2.53	−0.175	− 595	1013	0.298	418	0.123
Dec.	2.74	2.60	2.20	−0.315	−1071	937	0.276	− 134	−0.039
1882									
Jan.	2.425	2.25	1.69	−0.300	−1020	820	0.241	− 200	−0.059
Feb.	2.125	2.00	1.47	−0.180	− 612	769	0.226	157	0.046
Mar.	1.945	1.89	1.35	−0.095	− 323	741	0.218	418	0.123
April	1.85	1.81	1.30	+0.040	+ 136	730	0.215	866	0.255
May	1.89	1.97	1.71	+0.090	+ 306	824	0.242	1130	0.332
June	1.98	1.99	1.80	+0.235	+ 799	845	0.248	1644	0.483
July	2.215	2.44	2.15	+0.285	+ 969	926	0.272	1895	0.557
Aug.	2.50	2.56	2.25	+0.080	+ 272	949	0.279	1221	0.359
Sept.	2.58	2.60	2.19	−0.065	− 221	935	0.275	714	0.210
Oct.	2.515	2.43	2.10	−0.095	− 323	914	0.269	591	0.174
Nov.	2.42	2.41	2.04	−0.105	− 357	900	0.265	543	0.160
Dec.	2.315	2.22	1.77	−0.210	− 714	838	0.246	124	0.036
1883									
Jan.	2.105	1.99	1.34	−0.260	− 884	739	0.217	− 145	−0.043
Feb.	1.845	1.70	1.25	−0.145	− 493	718	0.211	225	0.066
Mar.	1.70	1.70	1.25	+0.125	+ 425	718	0.211	1143	0.336
April	1.825	1.95	1.32	+0.130	+ 442	734	0.216	1176	0.346
May	1.955	1.96	1.31	+0.055	+ 187	732	0.215	919	0.270
June	2.01	2.06	1.68	+0.175	+ 595	817	0.240	1412	0.415
July	2.185	2.31	1.86	+0.135	+ 459	859	0.253	1318	0.388
Aug.	2.32	2.33	2.28	−0.010	− 34	956	0.281	922	0.271
Sept.	2.31	2.29	1.95	−0.120	− 408	880	0.259	472	0.139
Oct.	2.19	2.09	1.80	−0.175	− 595	845	0.248	250	0.073
Nov.	2.015	1.94	1.69	−0.130	− 442	820	0.241	378	0.111
Dec.	1.885	1.83	1.43	−0.070	− 238	760	0.223	522	0.153

TABLE 24.—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

DATE.	WATER LEVELS OF—			STORAGE IN LAKE SUPERIOR.		OUTFLOW THROUGH ST. MARYS RIVER.		TOTAL SUPPLY TO LAKE SUPERIOR.	
	Lake Superior		St. Marys River.						
	Marquette, Mich. *a*		Sault Ste. Marie, Mich.						
	First of Month.	Mean of Month.	Mean of Month.	Ft. Depth.	100 c.f.s	100c.f.s	Ft. Depth, Lake Superior.	100 c.f.s.	Ft. Depth
1884									
Jan.	601.815	601.80	601.33	−0.100	− 340	737	0.217	397	0.117
Feb.	1.715	1.63	1.14	−0.130	− 442	693	0.204	251	0.074
Mar.	1.585	1.54	1.05	−0.155	− 527	672	0.198	145	0.043
April	1.43	1.32	0.88	0.000	0	633	0.186	633	0.186
May	1.43	1.54	1.25	+0.210	+ 714	718	0.211	1432	0.421
June	1.64	1.74	1.35	+0.170	+ 578	741	0.218	1319	0.388
July	1.81	1.88	1.57	+0.075	+ 255	792	0.233	1047	0.308
Aug.	1.885	1.89	1.61	+0.140	+ 476	801	0.236	1277	0.375
Sept.	2.025	2.16	1.68	+0.315	+1071	817	0.240	1888	0.555
Oct.	2.34	2.52	1.77	+0.130	+ 442	838	0.246	1280	0.376
Nov.	2.47	2.42	1.87	−0.155	− 527	861	0.253	334	0.098
Dec.	2.315	2.21	1.61	−0.220	− 748	801	0.236	53	0.016
1885									
Jan.	2.095	1.98	1.44	−0.205	− 697	762	0.224	65	0.019
Feb.	1.89	1.80	1.33	−0.130	− 442	737	0.217	295	0.087
Mar.	1.76	1.72	1.19	−0.065	− 221	704	0.207	483	0.142
April	1.695	1.67	1.02	+0.140	+ 476	665	0.196	1141	0.336
May	1.835	2.00	1.60	+0.305	+1037	799	0.235	1836	0.540
June	2.14	2.28	1.94	+0.260	+ 884	877	0.258	1761	0.518
July	2.40	2.52	2.12	+0.180	+ 612	919	0.270	1531	0.450
Aug.	2.58	2.64	2.34	+0.025	+ 85	969	0.285	1054	0.310
Sept.	2.605	2.57	2.10	−0.120	− 408	914	0.269	506	0.149
Oct.	2.485	2.40	1.92	−0.160	− 544	873	0.257	329	0.097
Nov.	2.325	2.25	1.85	−0.240	− 816	856	0.252	40	0.012
Dec.	2.085	1.92	1.55	−0.265	− 901	787	0.231	− 114	−0.034
1886									
Jan.	1.82	1.72	1.20	−0.165	− 561	707	0.208	146	0.043
Feb.	1.655	1.59	1.04	−0.095	− 323	670	0.197	347	0.102
Mar.	1.56	1.53	1.04	+0.015	+ 51	670	0.197	721	0.212
April	1.575	1.62	1.02	+0.170	+ 578	665	0.196	1243	0.365
May	1.745	1.87	1.50	+0.195	+ 663	776	0.228	1439	0.423
June	1.94	2.01	1.66	+0.105	+ 357	813	0.239	1170	0.344
July	2.045	2.08	1.83	−0.010	− 34	852	0.251	818	0.241
Aug.	2.035	1.99	1.97	−0.055	− 187	884	0.260	697	0.205
Sept.	1.98	1.97	1.83	+0.040	+ 136	852	0.251	988	0.291
Oct.	2.02	2.07	1.86	−0.025	− 85	859	0.253	774	0.228
Nov.	1.995	1.92	1.79	−0.145	− 493	843	0.248	350	0.103
Dec.	1.85	1.78	1.36	−0.225	− 765	744	0.219	− 21	−0.006
1887									
Jan.	1.625	1.47	1.14	−0.145	− 493	693	0.204	200	0.059
Feb.	1.48	1.49	1.00	+0.165	+ 561	661	0.194	1222	0.359
Mar.	1.645	1.80	0.97	+0.240	+ 816	654	0.192	1470	0.432
April	1.885	1.97	0.83	−0.020	− 68	622	0.183	554	0.163
May	1.865	1.76	1.19	−0.025	− 85	704	0.207	619	0.182
June	1.84	1.92	1.64	+0.220	+ 748	808	0.238	1556	0.458
July	2.06	2.20	2.01	+0.180	+ 612	893	0.263	1505	0.443
Aug.	2.24	2.28	1.89	−0.030	− 102	866	0.255	764	0.225
Sept.	2.21	2.14	1.75	−0.105	− 357	834	0.245	477	0.140
Oct.	2.105	2.07	1.93	−0.155	− 527	875	0.257	348	0.102
Nov.	1.95	1.83	1.70	−0.230	− 782	822	0.242	40	0.012
Dec.	1.72	1.61	1.29	−0.165	− 561	728	0.214	167	0.049

TABLE 24.—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

DATE.	WATER LEVELS OF— Lake Superior, Marquette, Mich. *a*		St. Marys River, Sault Ste. Marie, Mich.	STORAGE IN LAKE SUPERIOR.		OUTFLOW THROUGH ST. MARYS RIVER.		TOTAL SUPPLY TO LAKE SUPERIOR.	
	First of Month.	Mean of Month.	Mean of Month.	Ft. Depth.	100 c.f.s	100c.f.s	Ft. Depth, Lake Superior.	100 c.f.s.	Ft. Depth
1888									
Jan.	601.555	601.50	601.13	−0.050	− 170	691	0.203	521	0.153
Feb.	1.505	1.51	0.79	−0.030	− 102	612	0.180	510	0.150
Mar.	1.475	1.44	0.84	−0.035	− 119	624	0.183	505	0.148
April	1.44	1.44	0.83	+0.235	+ 799	622	0.183	1421	0.418
May	1.675	1.91	1.43	+0.625	+2126	760	0.223	2886	0.849
June	2.30	2.69	2.28	+0.485	+1650	956	0.281	2606	0.766
July	2.785	2.88	2.44	+0.165	+ 561	992	0.292	1553	0.457
Aug.	2.95	3.02	2.43	+0.045	+ 153	990	0.291	1143	0.336
Sept.	2.995	2.97	2.35	−0.070	− 238	972	0.286	734	0.216
Oct.	2.925	2.88	2.34	−0.115	− 391	969	0.285	578	0.170
Nov.	2.81	2.74	2.14	−0.245	− 833	923	0.271	90	0.026
Dec.	2.565	2.39	1.80	−0.335	−1139	778	0.229	− 361	−0.106
1889									
Jan.	2.23	2.07	1.52	−0.270	− 918	722	0.212	− 196	−0.058
Feb.	1.96	1.85	1.23	−0.195	− 663	664	0.195	1	0.000
Mar.	1.765	1.68	1.26	−0.080	− 272	670	0.197	398	0.117
April	1.685	1.69	1.25	+0.180	+ 612	668	0.196	1280	0.376
May	1.865	2.04	1.81	+0.235	+ 799	780	0.229	1579	0.464
June	2.10	2.16	1.99	+0.155	+ 527	816	0.240	1343	0.395
July	2.255	2.35	2.26	+0.190	+ 646	870	0.256	1516	0.446
Aug.	2.445	2.54	2.27	+0.160	+ 544	872	0.256	1416	0.416
Sept.	2.605	2.67	2.26	−0.015	− 51	870	0.256	819	0.012
Oct.	2.59	2.51	2.11	−0.235	− 799	840	0.247	41	0.241
Nov.	2.355	2.20	1.81	−0.305	−1037	780	0.229	− 257	−0.076
Dec.	2.05	1.90	1.43	−0.220	− 748	704	0.207	− 44	−0.013
1890									
Jan.	1.83	1.76	1.48	−0.135	− 459	714	0.210	255	0.075
Feb.	1.695	1.63	0.93	−0.185	− 629	604	0.178	− 25	−0.007
Mar.	1.51	1.39	0.92	−0.135	− 459	602	0.177	143	0.042
April	1.375	1.36	0.85	+0.090	+ 306	588	0.173	894	0.263
May	1.465	1.57	1.32	+0.330	+1122	682	0.201	1804	0.530
June	1.795	2.02	1.90	+0.375	+1275	798	0.235	2073	0.610
July	2.17	2.32	2.26	+0.225	+ 765	870	0.256	1635	0.481
Aug.	2.395	2.47	2.17	+0.140	+ 476	852	0.251	1328	0.390
Sept.	2.535	2.60	2.06	+0.050	+ 170	830	0.244	1000	0.294
Oct.	2.585	2.57	1.99	−0.120	− 408	816	0.240	408	0.120
Nov.	2.465	2.36	1.85	−0.285	− 969	788	0.232	− 181	−0.053
Dec.	2.18	2.00	1.55	−0.360	−1224	728	0.214	− 496	−0.146
1891									
Jan.	1.82	1.64	0.86	−0.245	− 833	590	0.173	− 243	−0.071
Feb.	1.575	1.51	0.97	−0.085	− 289	612	0.180	323	0.095
Mar.	1.49	1.47	0.82	−0.040	− 136	582	0.171	446	0.131
April	1.45	1.43	1.00	+0.080	+ 272	618	0.182	890	0.262
May	1.53	1.63	1.43	+0.125	+ 425	704	0.207	1129	0.332
June	1.655	1.68	1.38	+0.125	+ 425	694	0.204	1119	0.329
July	1.78	1.88	1.49	+0.090	+ 306	716	0.211	1022	0.301
Aug.	1.87	1.86	1.50	−0.030	− 102	718	0.211	616	0.181
Sept.	1.84	1.82	1.43	+0.025	+ 85	704	0.207	789	0.232
Oct.	1.865	1.91	1.49	−0.015	− 51	716	0.211	665	0.196
Nov.	1.85	1.79	1.38	−0.245	− 833	694	0.204	− 139	−0.041
Dec.	1.605	1.42	1.07	−0.185	− 629	632	0.186	3	0.001

TABLE 24.—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR

DATE.	WATER LEVELS OF—			STORAGE IN LAKE SUPERIOR.		OUTFLOW THROUGH ST. MARYS RIVER.		TOTAL SUPPLY TO LAKE SUPERIOR.	
	Lake Superior		St. Marys River.						
	Marquette, Mich. *a*		Sault Ste. Marie, Mich. Mean of Month.						
	First of Month.	Mean of Month.		Ft. Depth.	100 c.f.s	100c.f.s	Ft. Depth. Lake Superior.	100 c.f.s.	Ft. Depth
1892									
Jan.	601.42	601.42	601.01	−0.140	− 476	620	0.182	144	0.042
Feb.	1.28	1.14	0.65	−0.205	− 697	548	0.161	− 149	−0.044
Mar.	1.075	1.01	0.47	−0.060	− 204	512	0.151	308	0.091
April	1.015	1.02	0.63	+0.170	+ 578	544	0.160	1122	0.330
May	1.185	1.35	1.14	+0.355	+1207	646	0.190	1853	0.545
June	1.54	1.73	1.50	+0.205	+ 697	718	0.211	1415	0.416
July	1.745	1.76	1.64	+0.075	+ 255	746	0.219	1001	0.294
Aug.	1.82	1.88	1.65	+0.085	+ 289	748	0.220	1037	0.305
Sept.	1.905	1.93	1.71	−0.025	− 85	760	0.223	675	0.198
Oct.	1.88	1.83	1.60	−0.135	− 459	738	0.217	279	0.082
Nov.	1.745	1.66	1.32	−0.225	− 765	682	0.201	− 83	−0.024
Dec.	1.52	1.38	1.04	−0.280	− 952	626	0.184	− 326	−0.096
1893									
Jan.	1.24	1.10	0.79	−0.185	− 629	519	0.153	− 110	−0.032
Feb.	1.055	1.01	0.59	−0.020	− 68	482	0.142	414	0.122
Mar.	1.035	1.06	0.60	+0.075	+ 255	484	0.142	739	0.217
April	1.11	1.16	0.85	+0.300	+1020	531	0.156	1551	0.456
May	1.41	1.66	1.42	+0.510	+1734	638	0.188	2372	0.698
June	1.92	2.18	1.95	+0.410	+1394	738	0.217	2132	0.627
July	2.33	2.48	2.15	+0.180	+ 612	775	0.228	1387	0.408
Aug.	2.51	2.54	2.23	−0.015	− 51	790	0.232	739	0.217
Sept.	2.495	2.45	2.10	−0.060	− 204	766	0.225	562	0.165
Oct.	2.435	2.42	2.04	−0.095	− 323	755	0.222	432	0.127
Nov.	2.34	2.26	1.99	−0.195	− 663	745	0.219	82	0.024
Dec.	2.145	2.03	1.45	−0.195	− 663	644	0.189	− 19	−0.006
1894									
Jan.	1.94	1.85	1.23	−0.180	− 612	602	0.177	− 10	−0.003
Feb.	1.76	1.67	1.15	−0.045	− 153	587	0.173	434	0.128
Mar.	1.715	1.76	1.04	+0.120	+ 408	566	0.166	974	0.286
April	1.835	1.91	1.42	+0.465	+1582	638	0.188	2220	0.653
May	2.30	2.69	2.40	+0.500	+1700	822	0.242	2522	0.742
June	2.80	2.91	2.64	+0.140	+ 476	868	0.255	1344	0.395
July	2.94	2.97	2.78	+0.095	+ 323	894	0.263	1217	0.358
Aug.	3.035	3.10	2.79	+0.025	+ 85	896	0.263	981	0.288
Sept.	3.06	3.02	2.66	−0.030	− 102	871	0.256	769	0.226
Oct.	3.03	3.04	2.70	−0.015	− 51	879	0.258	828	0.243
Nov.	3.015	2.99	2.60	−0.120	− 408	860	0.253	452	0.133
Dec.	2.895	2.80	2.30	−0.245	− 833	804	0.236	− 29	−0.009
1895									
Jan.	2.65	2.50	2.00	−0.260	− 884	747	0.220	− 137	−0.040
Feb.	2.39	2.28	1.86	−0.195	− 663	721	0.212	58	0.017
Mar.	2.195	2.11	1.66	−0.135	− 459	683	0.201	224	0.066
April	2.06	2.01	1.64	+0.135	+ 459	679	0.200	1138	0.335
May	2.195	2.38	2.04	+0.345	+1173	755	0.222	1928	0.567
June	2.54	2.70	2.43	+0.260	+ 884	828	0.243	1712	0.503
July	2.80	2.90	2.67	+0.125	+ 425	873	0.257	1298	0.382
Aug.	2.925	2.95	2.68	+0.095	+ 323	875	0.257	1198	0.352
Sept.	3.02	3.09	2.85	+0.095	+ 323	907	0.267	1230	0.362
Oct.	3.115	3.14	2.97	−0.120	− 408	930	0.273	522	0.153
Nov.	2.995	2.85	2.45	−0.310	−1054	832	0.245	− 222	−0.065
Dec.	2.685	2.52	2.24	−0.265	− 901	830	0.244	− 71	−0.021

TABLE 24.—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

DATE.	WATER LEVELS OF—			STORAGE IN LAKE SUPERIOR.		OUTFLOW THROUGH ST. MARYS RIVER.		TOTAL SUPPLY TO LAKE SUPERIOR.	
	Lake Superior		St. Marys River.						
	Marquette, Mich. *a*		Sault Ste. Marie, Mich.						
	First of Month.	Mean of Month.	Mean of Month.	Ft. Depth.	100 c.f.s	100c.f.s	Ft. Depth, Lake Superior.	100 c.f.s.	Ft. Depth
1896									
Jan.	602.42	602.32	601.69	−0.200	− 680	727	0.214	47	0.014
Feb.	2.22	2.12	1.68	−0.200	− 680	687	0.202	7	0.002
Mar.	2.02	1.92	1.48	−0.055	− 187	649	0.191	462	0.136
April	1.965	2.01	1.57	+0.370	+1258	701	0.206	1959	0.576
May	2.335	2.66	2.18	+0.515	+1752	816	0.240	2568	0.755
June	2.85	3.04	2.59	+0.220	+ 748	893	0.263	1641	0.483
July	3.07	3.10	2.72	+0.040	+ 136	918	0.270	1054	0.310
Aug.	3.11	3.12	2.74	−0.075	− 255	921	0.271	666	0.196
Sept.	3.035	2.95	2.61	−0.245	− 833	897	0.264	64	0.019
Oct.	2.79	2.63	2.18	−0.125	− 425	816	0.240	391	0.115
Nov.	2.665	2.70	2.21	−0.040	− 136	822	0.242	686	0.202
Dec.	2.625	2.55	2.15	−0.155	− 527	810	0.238	283	0.083
1897									
Jan.	2.47	2.39	1.92	−0.195	− 663	767	0.226	104	0.031
Feb.	2.275	2.16	1.61	−0.155	− 527	709	0.208	182	0.053
Mar.	2.12	2.08	1.63	−0.025	− 85	712	0.209	627	0.184
April	2.095	2.11	1.76	+0.185	+ 629	737	0.217	1366	0.402
May	2.28	2.45	2.11	+0.335	+1139	803	0.236	1942	0.571
June	2.615	2.78	2.47	+0.315	+1071	871	0.256	1942	0.571
July	2.93	3.08	2.69	+0.210	+ 714	912	0.268	1626	0.478
Aug.	3.14	3.20	2.85	+0.030	+ 102	942	0.277	1044	0.307
Sept.	3.17	3.14	2.68	−0.130	− 442	910	0.268	468	0.138
Oct.	3.04	2.94	2.47	−0.250	− 850	871	0.256	21	0.006
Nov.	2.79	2.64	2.36	−0.365	−1241	850	0.250	− 391	−0.115
Dec.	2.425	2.21	1.87	−0.405	−1377	758	0.223	− 619	−0.182
1898									
Jan.	2.02	1.83	1.38	−0.280	− 952	670	0.197	− 282	−0.083
Feb.	1.74	1.65	1.15	−0.185	− 629	627	0.184	− 2	−0.001
Mar.	1.555	1.46	1.00	−0.095	− 323	599	0.176	276	0.081
April	1.46	1.46	1.13	+0.120	+ 408	623	0.183	1031	0.303
May	1.58	1.70	1.42	+0.360	+1224	678	0.199	1902	0.559
June	1.94	2.18	1.83	+0.445	+1513	755	0.222	2268	0.667
July	2.385	2.59	2.17	+0.270	+ 918	819	0.241	1737	0.511
Aug.	2.655	2.72	2.28	+0.115	+ 391	841	0.247	1232	0.362
Sept.	2.77	2.82	2.42	+0.020	+ 68	866	0.255	934	0.275
Oct.	2.79	2.76	2.26	−0.130	− 442	836	0.246	394	0.116
Nov.	2.66	2.56	2.09	−0.215	− 731	804	0.236	73	0.021
Dec.	2.445	2.33	2.01	−0.300	−1020	789	0.232	− 231	−0.068
1899									
Jan.	2.145	1.96	1.53	−0.285	− 969	699	0.206	−2701	−0.079
Feb.	1.86	1.76	1.37	−0.085	− 289	668	0.196	379	0.111
Mar.	1.775	1.79	1.26	0.000	0	648	0.191	648	0.191
April	1.775	1.76	1.26	+0.340	+1156	657	0.193	1813	0.533
May	2.115	2.47	2.12	+0.600	+2041	819	0.241	2860	0.841
June	2.715	2.96	2.56	+0.360	+1224	902	0.265	2126	0.625
July	3.075	3.19	2.76	+0.195	+ 663	940	0.276	1603	0.471
Aug.	3.27	3.35	2.91	+0.160	+ 544	968	0.285	1512	0.445
Sept.	3.43	3.51	3.10	−0.015	− 51	1004	0.295	953	0.280
Oct.	3.415	3.32	2.77	−0.150	− 510	942	0.277	432	0.127
Nov.	3.265	3.21	2.69	−0.160	− 544	926	0.272	382	0.112
Dec.	3.105	3.00	2.64	−0.290	− 986	917	0.270	− 69	−0.020

TABLE 24.—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

DATE.	WATER LEVELS OF—			STORAGE IN LAKE SUPERIOR.		OUTFLOW THROUGH ST. MARYS RIVER.		TOTAL SUPPLY TO LAKE SUPERIOR.	
	Lake Superior		St. Marys River.						
	Marquette, Mich. *a*		Sault Ste. Marie, Mich.						
	First of Month.	Mean of Month.	Mean of Month.	Ft. Depth.	100 c.f.s	100c.f.s	Ft. Depth, Lake Superior.	100 c.f.s.	Ft. Depth
1900									
Jan.	602.815	602.63	602.03	−0.275	− 935	793	0.233	− 142	−0.042
Feb.	2.54	2.45	1.90	−0.200	− 680	770	0.226	90	0.026
Mar.	2.34	2.23	1.64	−0.160	− 544	723	0.213	179	0.053
April	2.18	2.13	1.68	+0.035	+ 119	730	0.215	849	0.250
May	2.215	2.30	1.87	+0.115	+ 391	764	0.225	1155	0.340
June	2.33	2.36	1.94	+0.140	+ 476	777	0.228	1253	0.368
July	2.47	2.58	2.17	+0.290	+ 986	818	0.241	1804	0.530
Aug.	2.76	2.94	2.39	+0.440	+1496	857	0.252	2353	0.692
Sept.	3.20	3.46	2.90	+0.300	+1020	948	0.279	1968	0.579
Oct.	3.50	3.54	2.93	+0.025	+ 85	954	0.280	1039	0.305
Nov.	3.525	3.51	3.04	−0.205	− 697	974	0.286	277	0.081
Dec.	3.32	3.13	2.63	−0.365	−1241	900	0.265	− 341	−0.100
1901									
Jan.	2.955	2.78	2.17	−0.325	−1105	818	0.241	− 287	−0.084
Feb.	2.63	2.48	1.87	−0.250	− 850	764	0.225	− 86	0.025
Mar.	2.38	2.28	1.65	−0.130	− 442	725	0.213	283	−0.083
April	2.25	2.22	1.76	+0.115	+ 391	745	0.219	1136	0.334
May	2.365	2.51	2.06	+0.195	+ 663	798	0.235	1461	0.430
June	2.56	2.61	2.15	+0.290	+ 986	814	0.239	1800	0.529
July	2.85	3.09	2.56	+0.305	+1037	888	0.261	1925	0.566
Aug.	3.155	3.22	2.74	−0.025	− 85	920	0.270	835	0.246
Sept.	3.13	3.04	2.60	−0.075	− 255	895	0.263	640	0.188
Oct.	3.055	3.07	2.72	−0.020	− 68	798	0.235	730	0.215
Nov.	3.035	3.00	2.66	−0.195	− 663	788	0.232	125	0.037
Dec.	2.84	2.68	2.27	−0.340	−1156	728	0.214	− 428	−0.126
1902									
Jan.	2.50	2.32	1.90	−0.285	− 969	670	0.197	− 299	−0.088
Feb.	2.215	2.11	1.61	−0.175	− 595	625	0.184	30	0.009
Mar.	2.04	1.97	1.53	−0.045	− 153	613	0.180	460	0.135
April	1.995	2.02	1.69	+0.185	+ 629	638	0.188	1267	0.373
May	2.18	2.34	1.88	+0.310	+1054	667	0.196	1721	0.506
June	2.49	2.64	2.25	+0.270	+ 918	725	0.213	1643	0.483
July	2.76	2.88	2.48	+0.125	+ 425	760	0.223	1185	0.348
Aug.	2.885	2.89	2.49	+0.025	+ 85	762	0.224	847	0.249
Sept.	2.91	2.93	2.54	−0.040	− 136	770	0.226	634	0.186
Oct.	2.87	2.81	2.39	−0.060	− 204	746	0.219	542	0.159
Nov.	2.81	2.81	2.46	−0.115	− 391	757	0.223	366	0.108
Dec.	2.695	2.58	2.29	−0.285	− 969	731	0.215	− 238	0.070
1903									
Jan.	2.41	2.24	1.83	−0.300	−1020	660	0.194	− 360	−0.106
Feb.	2.11	1.98	1.60	−0.180	− 612	624	0.183	12	0.003
Mar.	1.93	1.88	1.51	+0.045	+ 153	610	0.179	763	0.224
April	1.975	2.07	1.76	+0.340	+1156	649	0.191	1805	0.531
May	2.315	2.56	2.15	+0.435	+1479	709	0.208	2188	0.643
June	2.75	2.94	2.57	+0.290	+ 986	774	0.228	1760	0.518
July	2.04	3.14	2.70	+0.155	+ 527	795	0.234	1322	0.389
Aug.	3.195	3.25	2.80	+0.065	+ 221	810	0.238	1031	0.303
Sept.	3.26	3.27	2.82	+0.075	+ 255	813	0.239	1068	0.314
Oct.	3.335	3.40	2.98	−0.045	− 153	838	0.246	685	0.201
Nov.	3.29	3.18	2.85	−0.300	−1020	818	0.241	− 202	−0.059
Dec.	2.99	2.80	2.41	−0.340	−1156	750	0.221	− 406	−0.119

TABLE 24.—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

DATE.	WATER LEVELS OF—			STORAGE IN LAKE SUPERIOR.		OUTFLOW THROUGH ST. MARYS RIVER.		TOTAL SUPPLY TO LAKE SUPERIOR.	
	Lake Superior		St. Marys River.						
	Marquette, Mich. *a*		Sault Ste. Marie, Mich. Mean of Month.						
	First of Month.	Mean of Month.		Ft. Depth.	100 c.f.s	100c.f.s	Ft. Depth. Lake Superior.	100 c.f.s.	Ft. Depth
1904									
Jan.	602.65	602.50	601.87	−0.235	− 799	666	0.196	− 133	−0.039
Feb.	2.445	2.33	1.64	−0.135	− 459	630	0.185	171	0.050
Mar.	2.28	2.23	1.40	−0.080	− 272	593	0.174	321	0.094
April	2.20	2.17	1.76	+0.120	+ 408	649	0.191	1057	0.311
May	2.32	2.47	2.09	+0.300	+1020	700	0.206	1720	0.506
June	2.62	2.77	2.34	+0.195	+ 663	739	0.217	1402	0.412
July	2.815	2.86	2.48	+0.090	+ 306	760	0.223	1066	0.313
Aug.	2.905	2.95	2.55	+0.110	+ 374	771	0.227	1145	0.337
Sept.	3.015	3.08	2.65	+0.155	+ 527	787	0.231	1314	0.386
Oct.	3.17	3.26	2.82	+0.055	+ 187	813	0.239	1000	0.294
Nov.	3.225	3.19	2.71	−0.260	− 884	796	0.234	− 88	−0.026
Dec.	2.965	2.74	2.30	−0.360	−1224	732	0.215	− 492	−0.145
1905									
Jan.	2.605	2.47	2.00	−0.305	−1037	788	0.232	− 249	−0.073
Feb.	2.30	2.13	1.59	−0.215	− 731	712	0.209	− 19	−0.001
Mar.	2.085	2.04	1.36	+0.060	+ 204	670	0.197	874	0.257
April	2.145	2.25	1.78	+0.225	+ 765	747	0.220	1512	0.445
May	2.37	2.49	2.07	+0.210	+ 714	801	0.236	1515	0.445
June	2.58	2.67	2.25	+0.240	+ 816	834	0.245	1650	0.485
July	2.82	2.97	2.60	+0.215	+ 731	899	0.264	1630	0.479
Aug.	3.035	3.10	2.73	+0.175	+ 595	923	0.271	1518	0.446
Sept.	3.21	3.32	2.92	+0.115	+ 391	958	0.282	1349	0.397
Oct.	3.325	3.33	2.96	−0.075	− 255	965	0.284	710	0.209
Nov.	3.25	3.17	2.73	−0.185	− 629	923	0.271	294	0.086
Dec.	3.065	2.96	2.52	−0.225	− 765	884	0.260	119	0.035
1906									
Jan.	2.84	2.72	2.18	−0.265	− 901	821	0.241	− 80	−0.024
Feb.	2.575	2.43	1.85	−0.250	− 850	760	0.223	− 90	0.026
Mar.	2.325	2.22	1.63	−0.140	− 476	720	0.212	244	0.072
April	2.185	2.15	1.70	+0.130	+ 442	733	0.216	1175	0.346
May	2.315	2.48	2.02	+0.315	+1071	792	0.233	1863	0.548
June	2.63	2.78	2.30	+0.210	+ 714	843	0.248	1557	0.458
July	2.84	2.90	2.50	+0.075	+ 255	880	0.259	1135	0.334
Aug.	2.915	2.93	2.46	+0.025	+ 85	873	0.257	958	0.282
Sept.	2.94	2.95	2.46	−0.045	− 153	873	0.257	720	0.212
Oct.	2.895	2.84	2.36	−0.145	− 493	855	0.251	362	0.106
Nov.	2.75	2.66	2.19	−0.195	− 663	823	0.242	160	0.047
Dec.	2.555	2.45	1.95	−0.220	− 748	779	0.229	31	0.009
1907									
Jan.	2.335	2.22	1.62	−0.195	− 663	718	0.211	55	0.016
Feb.	2.14	2.06	1.43	−0.140	− 476	683	0.201	207	0.061
Mar.	2.00	1.94	1.34	−0.060	− 204	666	0.196	462	0.136
April	1.94	1.94	1.59	+0.080	+ 272	712	0.209	984	0.289
May	2.02	2.10	1.71	+0.305	+1037	734	0.216	1771	0.521
June	2.325	2.55	2.12	+0.300	+1020	810	0.238	1830	0.538
July	2.625	2.70	2.33	+0.190	+ 646	849	0.250	1495	0.440
Aug.	2.815	2.93	2.50	+0.235	+ 799	880	0.259	1679	0.494
Sept.	3.05	3.17	2.70	+0.110	+ 374	917	0.270	1291	0.380
Oct.	3.16	3.15	2.71	−0.145	− 493	919	0.270	426	0.125
Nov.	3.015	2.88	2.56	−0.310	−1054	891	0.262	− 163	−0.048
Dec.	2.705	2.53	2.08			803	0.236		

TABLE 25. SUPPLY FACTORS OF LAKE MICHIGAN–HURON.

DATE	WATER LEVELS OF DETROIT RIVER. Windmill Point. First of Month.	Windmill Point. Mean of Month.	Amherstburg, Ont., Mean of Month.	STORAGE IN LAKE ST. CLAIR. Foot Depth.	STORAGE IN LAKE ST. CLAIR. Equivalent Foot Depth, Lake Michigan-Huron.	WATER LEVELS OF LAKE MICHIGAN-HURON. Milwaukee Wis., Mean of Month.	Harbor Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbor Beach. Mean of Month.	Mean, Milwaukee and Harbor Beach. First of Month.	STORAGE IN LAKE MICHIGAN-HURON, Foot Depth.	STORAGE IN LAKE MICHIGAN-HURON AND LAKE ST. CLAIR. Foot Depth, Lake Michigan-Huron.	STORAGE IN LAKE MICHIGAN-HURON AND LAKE ST. CLAIR. 100 c. f. s.	OUTFLOW THROUGH DETROIT RIVER. 100 c. f. s.	OUTFLOW THROUGH DETROIT RIVER. Ft. Depth Lake Michigan-Huron.	TOTAL SUPPLY TO LAKE MICHIGAN-HURON. 100 c. f. s.	TOTAL SUPPLY TO LAKE MICHIGAN-HURON. Foot Depth.	INFLOW FROM ST. MARYS RIVER. 100 c. f. s.	INFLOW FROM ST. MARYS RIVER. Ft. Depth Lake Michigan-Huron.	LOCAL SUPPLY TO LAKE MICHIGAN-HURON. 100 c. f. s.	LOCAL SUPPLY TO LAKE MICHIGAN-HURON. Foot Depth
1860																					
Jan.		575.92	573.48			582.51	582.83	582.67					2125	0.442				942	0.196		
Feb.	575.22	4.51	3.12	−0.14	−0.002	2.69	2.78	2.735	582.702	+0.076	+0.074	+ 356	1447	0.301	1803	0.375	880	0.183	923	0.192
Mar.	5.08	5.64	3.54	+0.86	+0.010	2.72	2.92	2.82	2.778	+0.067	+0.077	+ 370	1942	0.404	2312	0.481	874	0.182	1437	0.299
April	5.94	6.24	4.19	+0.52	+0.006	2.85	2.89	2.87	2.845	+0.067	+0.073	+ 351	2051	0.427	2402	0.500	932	0.194	1470	0.306
May	6.46	6.69	4.49	+0.30	+0.003	2.97	2.94	2.955	2.912	+0.133	+0.136	+ 654	2214	0.461	2868	0.597	1018	0.212	1850	0.385
June	6.76	6.84	4.45	−0.26	−0.003	3.09	3.18	3.135	3.045	+0.123	+0.120	+ 577	2326	0.484	2903	0.604	1062	0.221	1841	0.383
July	6.50	6.17	4.20	−0.38	−0.004	3.13	3.27	3.20	3.168	−0.036	−0.040	− 192	2002	0.417	1810	0.377	1062	0.221	748	0.156
Aug.	6.12	6.08	4.08	−0.26	−0.003	2.94	3.19	3.065	3.132	−0.164	−0.167	− 803	1995	0.415	1192	0.248	1075	0.224	117	0.024
Sept.	5.86	5.65	3.68	+0.12	+0.001	2.74	3.00	2.87	2.968	−0.270	−0.269	−1293	1894	0.394	601	0.125	1057	0.220	− 456	−0.095
Oct.	5.98	6.30	3.37	−0.14	−0.002	2.43	2.62	2.525	2.698	−0.286	−0.288	−1384	2376	0.494	992	0.206	1066	0.222	− 74	−0.015
Nov.	5.84	5.38	3.15	−0.18	−0.002	2.10	2.50	2.30	2.412	−0.227	−0.229	−1101	1935	0.403	834	0.174	1025	0.213	− 191	−0.040
Dec.	5.66	5.93	3.11	+0.30	+0.003	1.94	2.20	2.07	2.185	−0.195	−0.192	− 923	2250	0.468	1327	0.276	932	0.194	395	0.082
1861																				
Jan.	5.96	5.98	2.83	−0.67	−0.007	1.83	1.99	1.91	1.990	−0.048	−0.055	− 264	*a*2306	0.480	2042	0.425	875	0.182	1167	0.243
Feb.	5.29	4.60	2.55	−0.13	−0.001	1.92	2.03	1.975	1.942	+0.166	+0.165	+ 793	1723	0.358	2516	0.523	813	0.169	1703	0.354
Mar.	5.16	5.72	3.01	+0.96	+0.001	2.31	2.17	2.24	2.108	+0.207	+0.218	+1048	2166	0.451	3214	0.669	780	0.162	2434	0.506
April	6.12	6.51	4.00	+0.45	+0.005	2.41	2.37	2.39	2.315	+0.335	+0.340	+1634	2290	0.476	3924	0.816	870	0.181	3054	0.635
May	6.57	6.63	4.52	+0.17	+0.002	2.83	2.99	2.91	2.650	+0.385	+0.387	+1860	2164	0.450	4024	0.837	1048	0.218	2976	0.619
June	6.74	6.84	4.58	+0.06	+0.001	2.99	3.33	3.16	3.035	+0.187	+0.188	+ 904	2274	0.473	3178	0.661	1087	0.226	2091	0.435
July	6.80	6.77	4.34	+0.06	+0.001	3.12	3.45	3.285	3.222	+0.150	+0.151	+ 726	2324	0.484	3050	0.635	1133	0.236	1917	0.399
Aug.	6.86	6.95	4.42	−0.02	0.000	3.36	3.56	3.46	3.372	−0.010	−0.010	− 48	2409	0.501	2361	0.491	1126	0.234	1235	0.257
Sept.	6.84	6.73	4.18	−0.23	−0.003	3.05	3.48	3.265	3.362	−0.182	−0.185	− 889	2358	0.491	1469	0.306	1092	0.227	377	0.079
Oct.	6.61	6.49	3.94	−0.19	−0.002	2.93	3.26	3.095	3.180	−0.220	−0.222	−1067	2299	0.478	1232	0.256	1098	0.228	134	0.028
Nov.	6.42	6.34	3.79	−0.11	−0.001	2.70	2.95	2.825	2.960	−0.210	−0.211	−1014	2262	0.471	1248	0.260	1018	0.212	230	0.048
Dec.	6.31	6.28	3.68	−0.22	−0.002	2.53	2.82	2.675	2.750	−0.220	−0.222	−1067	2264	0.471	1197	0.249	919	0.191	278	0.058
1862																				
Jan.	6.09	5.90	3.65	−0.73	−0.008	2.33	2.44	2.385	2.530	−0.185	−0.193	− 928	2053	0.427	1125	0.234	826	0.172	299	0.062
Feb.	5.36	4.81	3.36	−0.07	−0.001	2.18	2.43	2.305	2.345	+0.013	+0.012	+ 58	1521	0.316	1579	0.328	778	0.162	801	0.167
Mar.	5.29	5.77	3.52	+1.09	+0.012	2.48	2.34	2.41	2.358	+0.144	+0.156	+ 750	2024	0.421	2774	0.577	785	0.163	1989	0.414
April	6.38	6.98	4.37	+0.63	+0.007	2.64	2.55	2.595	2.502	+0.248	+0.255	+1226	2446	0.509	3672	0.764	794	0.165	2878	0.599
May	7.01	7.04	4.70	+0.05	+0.001	2.89	2.92	2.905	2.750	+0.218	+0.219	+1053	2358	0.491	3411	0.710	983	0.204	2428	0.505
June	7.06	7.09	4.69	0.00	0.000	3.02	3.04	3.03	2.968	+0.050	+0.050	+ 240	2393	0.498	2633	0.548	986	0.205	1647	0.343
July	7.06	7.04	4.67	−0.08	−0.001	2.92	3.09	3.005	3.018	−0.020	−0.021	− 101	2370	0.493	2269	0.472	988	0.206	1281	0.266
Aug.	6.98	6.93	4.33	−0.17	−0.002	2.91	3.07	2.99	2.998	−0.080	−0.082	− 394	2428	0.505	2034	0.423	1029	0.214	1005	0.209
Sept.	6.81	6.69	3.96	−0.24	−0.003	2.84	2.85	2.845	2.918	−0.030	−0.033	− 159	2411	0.502	2252	0.469	1043	0.217	1209	0.252
Oct.	6.57	6.45	3.57	−0.28	−0.003	2.73	3.13	2.93	2.888	−0.136	−0.139	− 668	2398	0.499	1730	0.360	1027	0.214	703	0.146
Nov.	6.29	6.13	3.10	−0.25	−0.003	2.34	2.81	2.575	2.752	−0.284	−0.287	−1380	2362	0.491	982	0.204	949	0.197	33	0.007
Dec.	6.04	5.94	3.25	−0.02	0.000	2.20	2.52	2.36	2.468	−0.166	−0.166	− 798	2212	0.460	1414	0.294	875	0.182	539	0.112

a.—St. Clair River discharge used.

TABLE 25.—Continued. SUPPLY FACTORS OF LAKE MICHIGAN-HURON.

DATE	WATER LEVELS OF DETROIT RIVER. Windmill Point. First of Month.	Windmill Point. Mean of Month.	Amherstburg, Ont., Mean of Month.	STORAGE IN LAKE ST. CLAIR. Foot Depth.	STORAGE IN LAKE ST. CLAIR. Equivalent Foot Depth, Lake Michigan-Huron.	WATER LEVELS OF LAKE MICHIGAN-HURON. Milwaukee Wis., Mean of Month.	Harbor Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbor Beach. Mean of Month.	Mean, Milwaukee and Harbor Beach. First of Month.	STORAGE IN LAKE MICHIGAN-HURON, Foot Depth.	STORAGE IN LAKE MICHIGAN-HURON AND LAKE ST. CLAIR. Foot Depth, Lake Michigan-Huron.	STORAGE IN LAKE MICHIGAN-HURON AND LAKE ST. CLAIR. 100 c. f. s.	OUTFLOW THROUGH DETROIT RIVER. 100 c. f. s.	OUTFLOW THROUGH DETROIT RIVER. Ft. Depth Lake Michigan-Huron.	TOTAL SUPPLY TO LAKE MICHIGAN-HURON. 100 c. f. s.	TOTAL SUPPLY TO LAKE MICHIGAN-HURON. Foot Depth.	INFLOW FROM ST. MARYS RIVER. 100 c. f. s.	INFLOW FROM ST. MARYS RIVER. Ft. Depth Lake Michigan-Huron.	LOCAL SUPPLY TO LAKE MICHIGAN-HURON. 100 c. f. s.	LOCAL SUPPLY TO LAKE MICHIGAN-HURON. Foot Depth
1863																					
Jan.	576.02	576.09	573 68	+0.06	+0.001	582.13	582.36	582.245	582.302	−0.082	−0.081	− 389	2153	0.448	1764	0.367	820	0.171	944	0.196
Feb.	6.08	6.08	3.97	−0.12	−0.001	2.18	2.21	2.195	2.220	−0.040	−0 041	− 197	2040	0.424	1843	0.383	785	0.163	1058	0.220
Mar.	5.96	5.85	3.93	+0.15	+0 002	2.17	2.16	2.165	2.180	+0.002	+0.004	+ 19	1878	0.391	1897	0.395	746	0.155	1151	0.239
April	6.11	6.37	4.00	+0.43	+0.005	2.17	2.23	2.20	2.182	+0.150	+0.155	+ 745	2122	0.441	2867	0.596	750	0.156	2117	0.440
May	6.54	6.70	4.27	+0.10	+0.001	2.38	2.55	2.465	2.332	+0.188	+0.189	+ 909	2307	0.480	3216	0.669	813	0.169	2403	0.500
June	6.64	6.58	4.12	−0.05	−0.001	2.47	2.68	2.575	2.520	+0.020	+0.019	+ 91	2204	0.458	2295	0.477	799	0.166	1496	0.311
July	6.59	6.60	4.01	−0.01	0.000	2.42	2.59	2.505	2.540	−0.065	−0 065	− 312	2340	0.487	2028	0.422	840	0.175	1188	0.247
Aug.	6.58	6.57	3.97	−0.12	−0.001	2.29	2.60	2.445	2.475	−0.110	−0.111	− 534	2336	0.486	1802	0.375	986	0.205	816	0.170
Sept.	6.46	6.36	3.52	−0.37	−0.004	2.11	2.46	2.285	2.365	−0.167	−0.171	− 822	2363	0.492	1541	0.321	976	0.203	565	0.118
Oct.	6.09	5.82	3.07	−0.36	−0.004	2.02	2.20	2.11	2.198	−0.208	−0.212	−1019	2202	0.458	1183	0.246	937	0.195	246	0.051
Nov.	5.73	5.64	2.53	−0.14	−0.002	1.58	2.16	1.87	1.990	−0.092	−0.094	− 452	2263	0.471	1811	0.377	854	0.178	957	0.199
Dec.	5.59	5.54	2.62	+0.05	+0.001	1.92	1.93	1.925	1.898	−0.066	−0.065	− 312	2187	0.455	1875	0.390	817	0.170	1058	0.220
1864																				
Jan.	5.64	5.75	2.31	−0.18	−0.002	1.69	1.79	1.74	1.832	−0.137	−0.139	− 668	a2278	0.474	1610	0.335	739	0.154	871	0.181
Feb.	5.46	5.17	2.46	−0.22	−0.002	1.55	1.75	1.65	1.695	+0.017	+0.015	+ 72	2043	0.425	2115	0.440	686	0.143	1429	0.297
Mar.	5 24	5.31	2.69	+0.44	+0.005	1.80	1.75	1.775	1.712	+0.040	+0.045	+ 216	2048	0.426	2264	0.471	702	0.146	1562	0.325
April	5.68	6.04	3.14	+0.59	+0.007	1.51	1.95	1.73	1.752	+0.213	+0.220	+1058	a2201	0.458	3259	0.678	702	0.146	2557	0.532
May	6.27	6.50	3.93	+0.33	+0.004	2.02	2.38	2.20	1.965	+0.235	+0.239	+1149	2309	0.480	3458	0.719	771	0.160	2687	0.559
June	6.60	6.71	3.87	−0.02	0.000	2.01	2.39	2.20	2.200	−0.038	−0.038	− 183	2453	0.510	2270	0.472	810	0.169	1460	0.304
July	6.58	6.44	3.62	−0.24	−0.003	1.91	2.34	2.125	2.162	−0.110	−0.113	− 543	2376	0.494	1833	0.381	840	0.175	993	0.207
Aug.	6.34	6.25	3.39	−0.20	−0.002	1.73	2.23	1.98	2.052	−0.220	−0.222	−1067	2341	0.487	1274	0.264	845	0.176	429	0.089
Sept.	6 14	6.04	3.11	−0.36	−0.004	1.46	1.91	1.685	1.832	−0.377	−0.381	−1831	2310	0.481	479	0.100	866	0.180	− 387	−0.081
Oct.	5.78	5.51	2.79	−0.32	−0.004	1.07	1.38	1.225	1.455	−0.315	−0.319	−1533	2121	0.441	588	0.122	806	0.168	− 218	−0.045
Nov.	5.46	5.42	2.49	−0.02	0.000	0.90	1.21	1.055	1.140	−0.150	−0.150	− 721	2162	0.450	1441	0.300	760	0.158	681	0.141
Dec.	5.44	5.47	2.68	+0.64	+0.007	0.77	1.08	0.925	0.990	−0.208	−0.201	− 966	2133	0.444	1167	0.243	714	0.149	453	0.094
1865																				
Jan.	4.80	4.14	2.23	−1.00	−0.011	0.56	0.72	0.64	0.782	−0.097	−0.108	− 519	1594	0.332	1075	0.224	661	0.138	414	0.086
Feb.	3.80	3.45	1.65	+0.02	0.000	0.65	0.81	0.73	0.685	+0.130	+0.130	+ 625	1446	0.301	2071	0.431	654	0.136	1417	0.295
Mar.	3.82	4.18	1.99	+0.96	+0.011	0.82	0.98	0.90	0.815	+0.330	+0.341	+1639	1693	0.352	3332	0.693	624	0.130	2708	0 563
April	4.78	5.38	2.66	+0.90	+0.010	1.31	1.47	1.39	1.145	+0.325	+0.335	+1610	2092	0.435	3702	0.770	721	0.150	2981	0.620
May	5.68	5.97	3.33	+0.32	+0.004	1.47	1.63	1.55	1.470	+0.100	+0.104	+ 500	2204	0.458	2704	0.562	866	0.180	1838	0.382
June	6.00	6.02	3.30	+0.10	+0.001	1.51	1.67	1.59	1.570	+0.235	+0.236	+1134	2241	0.466	3375	0.702	965	0.201	2410	0.501
July	6.10	6.17	3.27	+0.06	+0.001	1.94	2.10	2.02	1.805	+0.225	+0.226	+1086	2333	0.485	3419	0.711	1048	0.218	2371	0.493
Aug.	6.16	6.16	3.23	−0.04	0.000	1.96	2.12	2.04	2.030	−0.050	−0.050	− 240	2340	0.487	2100	0.437	1068	0.222	1032	0.215
Sept.	6.12	6.07	3.13	−0.18	−0 002	1.84	2.00	1.92	1.980	−0.180	−0.182	− 875	2321	0.483	1446	0.301	1057	0.220	389	0.081
Oct.	5.94	5.82	2.82	−0.35	−0.004	1.60	1.76	1.68	1.800	−0.400	−0.404	−1942	2276	0.473	334	0.069	1009	0.210	− 675	−0.140
Nov.	5 59	5.36	2.31	−0.33	−0.004	1.04	1.20	1.12	1.400	−0.435	−0.439	−2110	2179	0.453	69	0.014	884	0.184	− 815	−0.170
Dec.	5.26	5.16	2.29	−0.16	−0.002	0.73	0.89	0.81	0.965	−0.285	−0.287	−1380	2087	0.434	707	0.147	801	0.167	− 94	−0.020

a.—St. Clair River discharge used.

1866																			
Jan.	5.10	5 03	2.00	—0.39	—0.003	0.47	0.63	0.55	0.680	—0.250	—0.253	—1216	*a*2026	0.421	810	0.169	723	0.150	87	0.018
Feb.	4.80	4.58	1.84	—0.18	—0.002	0.23	0.39	0.31	0.430	—0.095	—0.097	— 466	1928	0.401	1462	0.304	670	0.139	792	0.165
Mar.	4.62	4 66	2.25	+0.44	+0.005	0.28	0.44	0.36	0.335	+0.247	+0.252	+1211	1850	0.385	3061	0.637	670	0.139	2391	0.497
Apr.	5.06	5.46	2.78	+0.49	+0.005	0 73	0.88	0.805	0.582	+0.316	+0.321	+1543	*a*1964	0.409	3507	0.729	769	0.160	2738	0.570
May	5 55	5 64	3.09	+0.24	+0.003	0.91	1.07	0.99	0.898	+0.237	+0.240	+1154	2098	0.436	3252	0.677	859	0.179	2393	0.498
June	5 79	5.94	3.34	+0.26	+0.003	1.20	1.36	1.28	1.135	+0.275	+0.278	+1336	2183	0.454	3519	0.732	907	0.189	2612	0.543
July	6 05	6.16	3.46	+0.04	0.000	1.46	1.62	1.54	1.410	+0.160	+0.160	+ 769	2268	0.472	3037	0.632	983	0.204	2054	0.427
Aug.	6.09	6 02	3.25	—0.11	—0.001	1 52	1.68	1.60	1.570	—0.045	—0.046	— 221	2256	0.469	2035	0.423	1038	0.216	997	0.205
Sept.	5.98	5.93	3.13	—0.07	—0.001	1.37	1.53	1.45	1.525	—0.130	—0.131	— 630	2243	0.467	1613	0.336	962	0.200	651	0.135
Oct.	5.91	5.89	3.11	—0.10	—0.001	1.26	1.42	1.34	1.395	—0.100	—0.101	— 486	2228	0.463	1742	0.362	967	0.201	775	0.161
Nov.	5.81	5.73	2.74	—0.03	0.000	1.17	1.33	1.25	1.295	—0.175	—0.175	— 841	2295	0.477	1454	0.302	889	0.185	565	0.118
Dec.	5.78	5.84	2.87	—0.40	—0.004	0.91	1.07	0.99	1.120	—0.140	—0.144	— 692	2272	0.473	1580	0.329	903	0.188	677	0.141
1867																				
Jan.	5.38	4.91	2.56	+0.55	+0.006	0.89	1.05	0.97	0.980	+0.015	+0.021	+ 101	1881	0.391	1982	0.412	829	0.172	1153	0.240
Feb.	5.93	4.95	2.24	—1.19	—0.013	0.94	1.10	1.02	0.995	+0.115	+0.102	+ 490	1996	0.415	2486	0.517	799	0.166	1687	0.351
Mar.	4.74	4.52	2.66	+0.42	+0.005	1.12	1.28	1.20	1.110	+0.235	+0.240	+1154	1641	0.341	2795	0.581	755	0.157	2040	0.424
Apr.	5 16	5.80	2.93	+0.87	+0.010	1.41	1.57	1.49	1.345	+0.255	+0.265	+1274	*a*2118	0.441	3392	0.706	801	0.167	2591	0.539
May	6.03	6.26	3 54	+0.43	+0.005	1.63	1.79	1.71	1.600	+0.265	+0.270	+1298	2299	0.478	3597	0.748	834	0.173	2763	0.575
June	6 46	6.65	3.84	+0.10	+0.001	1.94	2.10	2.02	1.865	+0.230	+0.231	+1110	2427	0.505	3537	0.736	976	0.203	2561	0.533
July	6 56	6.47	3 66	—0 13	—0.001	2 09	2.25	2.17	2 095	+0.040	+0.039	+ 187	2381	0 495	2568	0.534	1062	0.221	1506	0.313
Aug.	6 43	6.39	3 39	—0 23	—0.003	2.02	2.18	2.10	2.135	—0.170	—0.173	— 832	2420	0 503	1588	0.330	1036	0.216	552	0.115
Sept.	6.20	6 00	2.94	—0 40	—0 004	1.75	1.91	1.83	1.965	—0.300	—0.304	—1461	2337	0 486	876	0.182	1041	0.217	— 165	—0.034
Oct.	5.80	5 61	2 59	—0 44	—0 005	1.42	1.58	1.50	1.665	—0.395	—0.400	—1923	2231	0.464	308	0.064	1036	0.216	— 728	—0.151
Nov.	5 36	5 12	1.96	—0 33	—0.004	0.96	1.12	1.04	1.270	—0.405	—0.409	—1966	2154	0.448	188	0.039	935	0.195	— 747	—0.155
Dec.	5.03	4 94	1.86	—0.12	—0.001	0.61	0.77	0.69	0.865	—0.255	—0.256	—1231	2093	0.435	862	0.179	850	0.177	12	0.002
1868																				
Jan.	4.91	4 88	1.64	—0 56	—0.006	0.45	0.61	0.53	0.610	—0.100	—0.106	— 510	*a*2042	0.425	1532	0.319	801	0.167	731	0.152
Feb.	4.35	3.82	1 26	+0.13	+0.001	0.41	0.57	0.49	0.510	+0.320	+0.321	+1543	1733	0.361	3276	0.682	661	0.138	2615	0.544
Mar.	4.48	5 13	1.87	+0.78	+0 009	1.09	1.25	1.17	0.830	+0.290	+0.299	+1437	2179	0.453	3616	0.752	744	0.155	2872	0.597
Apr.	5.26	5.38	2.65	+0 38	+0.004	0.99	1.15	1.07	1.120	+0.090	+0.094	+ 452	2095	0.436	2547	0.530	783	0.163	1764	0.367
May	5.64	5 90	3.19	+0 42	+0.005	1.27	1.43	1.35	1.210	+0.245	+0.250	+1202	2209	0.460	3411	0.710	907	0.189	2504	0.521
June	6.06	6.22	3 57	+0.10	+0.001	1.48	1.64	1.56	1.455	+0.120	+0.121	+ 582	2266	0.471	2848	0.592	891	0.185	1957	0.407
July	6.16	6 11	3 55	—0.22	—0 002	1.51	1.67	1 59	1.575	—0.155	—0.157	— 755	2211	0.460	1456	0.303	951	0.198	505	0.105
Aug.	5 94	5 78	3.07	—0 28	—0 003	1 17	1.33	1.25	1 420	—0.290	—0.293	—1408	2180	0.454	772	0.161	935	0.195	— 163	—0.034
Sept.	5.66	5.53	2.74	—0 34	—0.004	0.93	1.09	1.01	1.130	—0.235	—0.239	—1149	2146	0.446	997	0.207	951	0.198	46	0.010
Oct.	5 32	5 11	2.28	—0 34	—0.004	0.70	0.86	0.78	0.895	—0.150	—0.154	— 740	2064	0.429	1324	0.275	944	0 196	380	0.079
Nov.	4 98	4 85	1.99	—0.18	—0 002	0.63	0 79	0.71	0.745	—0.175	—0.177	— 851	2016	0.419	1165	0.242	979	0.204	186	0.039
Dec.	4 80	4 76	1.90	—0 21	—0.002	0.35	0.51	0.43	0.570	—0.190	—0.192	— 923	1998	0.416	1075	0.224	868	0.181	207	0.043
1869																				
Jan.	4 59	4.42	1.87	—0 35	—0 004	0 25	0.41	0 33	0 380	—0.015	—0.019	— 91	1844	0 384	1753	0.365	806	0.168	947	0.197
Feb.	4 24	4 06	1.80	—0 07	—0 001	0.32	0.48	0.40	0 365	—0.095	—0.096	— 461	1692	0 352	1231	0.256	746	0.155	485	0.101
Mar.	4.17	4 28	2.30	+0.51	+0 006	0.06	0.22	0 14	0.270	+0.055	+0.061	+ 293	1607	0.334	1900	0.395	642	0.134	1258	0.262
Apr.	4 68	5 09	2.55	+0 49	+0 005	0.43	0.59	0 51	0 325	+0.350	+0.355	+1706	1976	0 411	3682	0.766	771	0.160	2911	0.606
May	5 17	5 25	3.19	+0 36	+0 004	0.76	0.92	0 84	0.675	+0.430	+0.434	+2086	1848	0.384	3934	0.818	896	0.186	3038	0.632
June	5 53	5 81	3 57	+0 50	+0 006	1 29	1.45	1 37	1.105	+0.455	+0 461	+2216	2030	0.422	4246	0.883	903	0 188	3343	0.695
July	6 03	6 25	3 86	+0 23	+0 003	1.67	1.83	1.75	1 560	+0 320	+0.323	+1553	2184	0 454	3737	0.777	997	0 207	2740	0.570
Aug.	6 26	6 26	3 80	—0 12	—0 001	1 93	2 09	2 01	1 880	+0.075	+0.074	+ 356	2211	0.460	2567	0 534	1105	0.230	1462	0.304
Sept.	6 14	6 03	3 47	—0 34	—0.004	1 82	1 98	1 90	1 955	—0.235	0.239	1149	2192	0.456	1043	0 217	1287	0 268	— 244	—0.051
Oct.	5 80	5 58	3 01	—0 36	—0 004	1 46	1 62	1.54	1.720	—0 240	—0.244	1173	2091	0.435	918	0.191	1168	0 243	— 250	—0.052
Nov.	5 44	5.30	2 42	0 00	0 000	1.34	1 50	1 42	1.480	—0.200	—0.200	— 961	2121	0.441	1160	0.241	1087	0.226	73	0.015
Dec	5 44	5 59	2 89	+0 56	+0.006	1 06	1.22	1.14	1 280	—0.110	—0.104	— 500	2133	0.444	1633	0.340	926	0 193	707	0 147

a.—St. Clair River discharge used.

TABLE 25.—Continued. SUPPLY FACTORS OF LAKE MICHIGAN-HURON.

DATE	WATER LEVELS OF DETROIT RIVER. Windmill Point. First of Month.	Windmill Point. Mean of Month.	Amherstburg, Ont., Mean of Month.	STORAGE IN LAKE ST. CLAIR. Foot Depth.	STORAGE IN LAKE ST. CLAIR. Equivalent Foot Depth, Lake Michigan-Huron.	WATER LEVELS OF LAKE MICHIGAN-HURON. Milwaukee Wis., Mean of Month.	Harbor Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbor Beach. Mean of Month.	Mean, Milwaukee and Harbor Beach. First of Month.	STORAGE IN LAKE MICHIGAN-HURON, Foot Depth.	STORAGE IN LAKE MICHIGAN-HURON AND LAKE ST. CLAIR. Foot Depth, Lake Michigan-Huron.	STORAGE IN LAKE MICHIGAN-HURON AND LAKE ST. CLAIR. 100 c. f. s.	OUTFLOW THROUGH DETROIT RIVER. 100 c. f. s.	OUTFLOW THROUGH DETROIT RIVER. Ft. Depth Lake Michigan-Huron.	TOTAL SUPPLY TO LAKE MICHIGAN-HURON. 100 c. f. s.	TOTAL SUPPLY TO LAKE MICHIGAN-HURON. Foot Depth.	INFLOW FROM ST. MARYS RIVER. 100 c. f. s.	INFLOW FROM ST. MARYS RIVER. Ft. Depth Lake Michigan-Huron.	LOCAL SUPPLY TO LAKE MICHIGAN-HURON. 100 c. f. s.	LOCAL SUPPLY TO LAKE MICHIGAN-HURON. Foot Depth
1870																				
Jan.	576 00	576 40	573 11	−0 20	−0 092	581 12	581 28	581 20	581 170	+0 075	+0.073	+ 351	a2021	0.420	2372	0.493	856	0.178	1516	0.315
Feb.	5 80	5.19	3 34	−0 60	−0 007	1.21	1 37	1 29	1 245	+0.195	+0.188	+ 904	1757	0.366	2661	0.554	804	0.167	1857	0 386
Mar.	5 20	5.22	3 13	+0.47	+0 065	1.51	1.67	1 59	1.440	+0.360	+0.365	+1755	1853	0 385	3608	0.751	806	0.168	2802	0 583
April	5 67	6.12	3 73	+0.66	+0.007	1.93	2 09	2 01	1.800	+0.380	+0 387	+1860	2154	0.448	4014	0.835	824	0.171	3190	0 664
May	6 33	6.54	4 03	+0 25	+0 003	2.27	2.43	2 35	2.180	+0.240	+0.243	+1168	2212	0 460	3380	0 703	932	0.194	2448	0.509
June	6.58	6.61	3 99	+0.13	+0 001	2.41	2 57	2.49	2 420	+0.125	+0 126	+ 606	2354	0.490	2960	0 616	893	0 186	2067	0 430
July	6.71	6.81	4 04	+0 07	+0.001	2.52	2.68	2.60	2.545	+0.010	+0.011	+ 53	2456	0.511	2509	0.522	946	0 197	1563	0.325
Aug.	6.78	6.76	4 03	−0 16	−0.002	2 43	2 59	2.51	2.555	+0 025	+0.023	+ 111	2431	0.506	2542	0 529	949	0.197	1593	0.331
Sept.	6.62	6.49	3.72	−0.35	−0.004	2 57	2.73	2.65	2 580	−0.130	−0.134	− 644	2373	0.494	1729	0.360	974	0 203	755	0.157
Oct.	6.27	6.05	3.33	−0.34	−0.004	2.17	2.33	2.25	2 450	−0.400	−0.404	−1942	2248	0.468	306	0.064	937	0 195	− 631	−0.131
Nov.	5.93	5.81	2.90	−0.15	−0.002	1.77	1.93	1.85	2.050	−0.375	−0.377	−1812	2248	0.468	436	0 091	893	0 186	− 457	−0.095
Dec.	5 78	5.74	2.90	−0.25	−0.003	1.42	1.58	1.50	1.675	−0.100	−0.103	− 495	2210	0.460	1715	0.357	668	0 139	1047	0.218
1871																				
Jan.	5 53	5.32	2.67	−0.68	−0.008	1.57	1.73	1.65	1.575	+0 635	+0 027	+ 130	2059	0.428	2189	0.455	744	0.155	1445	0.301
Feb.	4.85	4.38	2.34	+0.39	+0.004	1 49	1.65	1.57	1.610	+0.260	+0.264	+1269	1679	0.349	2948	0 613	707	0.147	2241	0.466
Mar.	5.24	6 10	2.81	+0 92	+0.010	2 09	2 25	2.17	1.870	+0.400	+0.410	+1971	a2257	0.470	4228	0 880	644	0.134	3584	0.746
April	6 16	6 22	3.24	+0 21	+0.002	2 29	2 45	2.37	2 270	+0 275	+0 277	+1332	2370	0.493	3702	0 770	677	0.141	3025	0.629
May	6.37	6 52	3 60	+0.19	+0.002	2.64	2 80	2.72	2.545	+0.195	+0.197	+ 947	2429	0.505	3376	0.702	808	0.168	2568	0.534
June	6 56	6.59	3 62	+0.03	0.000	2.68	2 84	2.76	2.740	+0.035	+0.035	+ 168	2463	0.512	2631	0.547	903	0.188	1728	0.359
July	6 59	6 59	3 61	−0.09	−0.001	2.71	2.87	2.79	2.775	−0.120	−0.121	− 582	2466	0 513	1884	0.392	944	0 196	940	0.196
Aug.	6 50	6.41	3 44	−0.24	−0.003	2.48	2.56	2 52	2.655	−0.383	−0.386	−1856	2415	0.502	559	0.116	926	0.192	− 367	−0.076
Sept.	6.26	6.11	3.21	−0.46	−0.005	1.81	2.24	2.025	2.272	−0.544	−0.549	−2639	2319	0.482	− 320	−0.067	937	0.195	−1257	−0.261
Oct.	5.80	5 49	2.53	−0.40	−0.004	1.12	1.74	1.43	1.728	−0.363	−0.367	−1764	2186	0.455	422	0.088	891	0.185	− 469	−0.098
Nov.	5.40	5.30	2.22	−0.02	0.000	1.07	1.53	1.30	1.365	−0.305	−0.305	−1466	2174	0.452	708	0.147	840	0.175	− 132	−0.027
Dec.	5.38	5.47	1 90	−0.30	−0.003	0.48	1.16	0.82	1.060	−0.315	−0.318	−1529	2334	0.486	805	0.167	750	0.156	55	0.011
1872																				
Jan.	5.08	4.70	1.80	−0.40	−0.004	0.35	0.99	0.67	0.745	−0.125	−0.129	− 620	1995	0.415	1375	0.286	693	0.144	682	0.142
Feb.	4.68	4.65	1.56	−0.16	−0.002	0.35	0.79	0.57	0.620	−0.230	−0.232	−1115	2032	0.423	917	0.191	674	0.140	243	0.051
Mar.	4.52	4.40	1 49	+0.10	+0.001	0.13	0.29	0.21	0.390	−0.012	−0.011	− 53	1936	0.403	1883	0.392	619	0.129	1264	0.263
April	4.62	4.84	1 64	+0.36	+0.004	0.38	0.71	0.545	0.378	+0.330	+0.334	+1606	a1996	0.415	3602	0.749	610	0.127	2992	0.622
May	4.98	5.12	2.17	+0.36	+0.004	0.63	1.11	0.87	0.708	+0.354	+0.358	+1721	2100	0.437	3821	0.795	815	0.170	3006	0.625
June	5.34	5.55	2.53	+0.06	+0.001	1.00	1.51	1.255	1.062	+0.226	+0.227	+1091	2217	0.461	3308	0.688	854	0.178	2454	0.511
July	5.40	5.24	2 53	−0 08	−0.001	1.03	1.61	1.32	1.288	+0.020	+0 019	+ 91	2059	0.428	2150	0.447	946	0.197	1204	0.250
Aug.	5.32	5.39	2.54	−0.02	0.000	1.01	1.58	1.295	1.308	−0.056	−0.056	− 269	2132	0.444	1863	0.388	1020	0.212	843	0.175
Sept.	5.30	5.22	2.25	−0.11	−0.001	0.94	1.48	1.21	1.252	−0.102	−0.103	− 495	2126	0.442	1631	0.339	1036	0.216	595	0.124
Oct.	5.19	5.16	2.07	−0.28	−0.003	0.82	1.36	1.09	1.150	−0.208	−0.211	−1014	2146	0.446	1132	0.235	1002	0.208	130	0.027
Nov.	4.91	4.66	1.61	−0.30	−0.003	0.53	1.06	0.795	0.942	−0.384	−0.387	−1860	2024	0.421	164	0.034	967	0.201	− 803	−0.167
Dec.	4.61	4.56	1.50	−0.31	−0.003	579.87	0.77	0.32	0.558	−0.280	−0.283	−1360	2005	0.417	645	0.134	863	0.180	− 218	−0.045

1873																			
Jan.	4.30	4.03	1.38	−0.12	−0.001	9.87	0.60	0.235	0.278	−0.040	−0.041	− 197	1796	0.374	1599	0.333	771	0.160	828	0.172
Feb.	4.18	4.32	1.39	+0.32	+0.004	9.91	0.57	0.24	0.238	+0.097	+0.101	+ 485	1924	0.400	2410	0.501	732	0.152	1678	0.349
Mar.	4.50	4.69	1.48	+0.65	+0.007	580.22	0.61	0.43	0.335	+0.340	+0.347	+1668	2069	0.430	3737	0.777	737	0.153	3000	0.624
Apr.	5.15	5.61	2.71	+0.50	+0.006	0.79	1.05	0.92	0.675	+0.510	+0.516	+2480	*a*1991	0.414	4471	0.930	741	0.154	3730	0.776
May	5.65	5.69	3.17	+0.18	+0.002	1.35	1.55	1.45	1.185	+0.523	+0.525	+2524	1997	0.415	4521	0.940	870	0.181	3651	0.759
June	5.83	5.97	3.54	+0.19	+0.002	1.98	1.95	1.965	1.708	+0.297	+0.299	+1437	2133	0.444	3570	0.743	900	0.187	2670	0.555
July	6.02	6.07	3.53	+0.05	+0.001	1.94	2.15	2.045	2.005	+0.067	+0.068	+ 327	2195	0.457	2522	0.525	1002	0.208	1520	0.316
Aug.	6.07	6.07	3.51	−0.13	−0.001	2.04	2.16	2.10	2.072	−0.062	−0.063	− 303	2201	0.458	1898	0.395	1059	0.220	839	0.175
Sept.	5.94	5.81	3.05	−0.28	−0.003	1.85	1.99	1.92	2.010	−0.112	−0.115	− 553	2202	0.458	1649	0.343	1075	0.224	574	0.119
Oct.	5.66	5.52	2.74	−0.24	−0.003	1.79	1.96	1.875	1.898	−0.106	−0.109	− 524	2141	0.445	1617	0.336	1048	0.218	569	0.119
Nov.	5.42	5.32	2.41	−0.02	0.000	1.56	1.86	1.71	1.792	−0.132	−0.132	− 635	2134	0.444	1499	0.312	997	0.207	502	0.104
Dec.	5.40	5.47	2.90	−0.34	−0.004	1.52	1.70	1.61	1.660	−0.055	−0.059	− 284	2067	0.430	1783	0.371	942	0.196	841	0.175
1874																				
Jan.	5.06	4.66	3.27	−0.69	−0.008	1.48	1.72	1.60	1.605	+0.103	+0.095	+ 457	1470	0.306	1927	0.401	815	0.170	1112	0.231
Feb.	4.37	4.08	3.32	+0.44	+0.005	1.77	1.86	1.815	1.708	+0.180	+0.185	+ 889	1053	0.219	1942	0.404	778	0.162	1164	0.242
Mar.	4.81	5.54	3.37	+0.86	+0.010	1.92	2.00	1.96	1.888	+0.010	+0.020	+ 96	1947	0.405	2043	0.425	753	0.157	1290	0.268
Apr.	5.67	5.80	3.49	+0.14	+0.002	1.82	1.85	1.835	1.898	−0.056	−0.054	− 260	2053	0.427	1793	0.373	725	0.151	1068	0.222
May	5.81	5.82	3.67	+0.12	+0.001	1.80	1.90	1.85	1.842	+0.186	+0.187	+ 899	1998	0.416	2897	0.603	822	0.171	2075	0.432
June	5.93	6.04	3.73	+0.17	+0.002	2.17	2.24	2.205	2.028	+0.200	+0.202	+ 971	2106	0.438	3077	0.640	921	0.192	2156	0.449
July	6.10	6.17	3.77	+0.03	0.000	2.10	2.40	2.25	2.228	−0.003	−0.003	− 14	2168	0.451	2154	0.448	1006	0.209	1148	0.239
Aug.	6.13	6.09	3.65	−0.16	−0.002	2.11	2.29	2.20	2.225	−0.133	−0.135	− 649	2164	0.450	1515	0.315	1020	0.212	495	0.103
Sept.	5.97	5.85	3.13	−0.26	−0.003	1.86	2.11	1.985	2.092	−0.262	−0.265	−1274	2200	0.458	926	0.193	1016	0.211	− 90	−0.019
Oct.	5.71	5.57	2.68	−0.29	−0.003	1.51	1.84	1.675	1.830	−0.340	−0.343	−1649	2185	0.455	536	0.112	1045	0.217	− 509	−0.106
Nov.	5.42	5.27	2.13	−0.34	−0.004	1.31	1.30	1.305	1.490	−0.222	−0.236	−1134	2183	0.454	1049	0.218	995	0.207	54	0.011
Dec.	5.08	4.90	2.04	−0.27	−0.003	0.97	1.45	1.21	1.258	−0.170	−0.173	− 832	2027	0.422	1195	0.249	972	0.202	223	0.046
1875																				
Jan.	4.81	4.72	1.79	−0.09	−0.001	0.77	1.16	0.965	1.088	−0.156	−0.157	− 755	2008	0.418	1253	0.261	866	0.180	387	0.081
Feb.	4.72	4.71	1.62	+0.08	+0.001	0.70	1.10	0.90	0.932	−0.007	−0.006	− 29	2045	0.425	2016	0.419	808	0.168	1208	0.251
Mar.	4.80	4.90	1.78	+0.12	+0.001	0.76	1.14	0.95	0.925	+0.163	+0.164	+ 788	2093	0.435	2881	0.599	799	0.166	2082	0.433
Apr.	4.92	4.95	2.13	+0.34	+0.004	1.12	1.33	1.225	1.088	+0.364	+0.368	+1769	2027	0.422	3796	0.790	856	0.178	2940	0.612
May	5.26	5.58	2.69	+0.41	+0.005	1.68	1.68	1.68	1.452	+0.366	+0.371	+1783	2187	0.455	3970	0.826	928	0.193	3042	0.633
June	5.67	5.76	3.11	+0.19	+0.002	1.92	1.99	1.955	1.818	+0.177	+0.179	+ 860	2157	0.449	3017	0.628	997	0.207	2020	0.420
July	5.86	5.95	3.25	+0.06	+0.001	1.89	2.18	2.035	1.995	+0.075	+0.076	+ 365	2218	0.461	2583	0.537	1016	0.211	1567	0.326
Aug.	5.92	5.89	3.28	−0.12	−0.001	2.06	2.15	2.105	2.070	+0.028	+0.027	+ 130	2175	0.452	2305	0.480	1020	0.212	1285	0.267
Sept.	5.80	5.71	3.08	−0.20	−0.002	1.99	2.19	2.09	2.098	−0.093	−0.095	− 457	2140	0.445	1683	0.350	1085	0.226	598	0.124
Oct.	5.60	5.50	2.58	−0.20	−0.002	1.84	2.00	1.92	2.005	−0.165	−0.167	− 803	2177	0.453	1374	0.286	1055	0.219	319	0.066
Nov.	5.40	5.31	2.30	−0.17	−0.002	1.63	1.89	1.76	1.840	−0.195	−0.197	− 947	2158	0.449	1211	0.252	990	0.206	221	0.046
Dec.	5.23	5.15	2.64	−0.02	0.000	1.44	1.62	1.53	1.645	−0.097	−0.097	− 466	1980	0.412	1514	0.315	861	0.179	653	0.136
1876																				
Jan.	5.21	5.27	2.58	+0.31	+0.003	1.39	1.74	1.565	1.548	+0.062	+0.065	+ 312	2060	0.429	2372	0.493	854	0.178	1518	0.316
Feb.	5.52	5.78	3.14	+0.66	+0.007	1.59	1.72	1.655	1.610	+0.160	+0.167	+ 803	2160	0.449	2963	0.616	843	0.175	2120	0.441
Mar.	6.18	6.59	3.81	+0.42	+0.005	1.92	1.85	1.885	1.770	+0.235	+0.240	+1154	*a*2188	0.455	3342	0.695	783	0.163	2559	0.532
Apr.	6.60	6.60	4.28	−0.08	−0.001	2.12	2.13	2.125	2.005	+0.425	+0.424	+2038	2240	0.466	4278	0.890	792	0.165	3486	0.725
May	6.52	6.43	4.69	+0.36	+0.004	2.74	2.73	2.735	2.430	+0.530	+0.534	+2567	1955	0.407	4522	0.941	958	0.199	3564	0.741
June	6.88	7.33	4.79	+0.51	+0.006	3.15	3.22	3.185	2.960	+0.420	+0.426	+2048	2511	0.522	4559	0.948	1092	0.227	3467	0.721
July	7.39	7.45	4.69	−0.02	0.000	3.49	3.66	3.575	3.380	+0.162	+0.162	+ 779	2627	0.546	3406	0.709	1200	0.250	2206	0.459
Aug.	7.37	7.29	4.43	−0.33	−0.004	3.42	3.60	3.51	3.542	−0.072	−0.076	− 365	2618	0.545	2253	0.469	1211	0.252	1041	0.217
Sept.	7.04	6.79	4.20	−0.44	−0.005	3.37	3.49	3.43	3.470	−0.285	−0.290	−1394	2389	0.497	995	0.207	1218	0.253	− 223	−0.046
Oct.	6.60	6.42	3.66	−0.24	−0.003	2.79	3.09	2.94	3.185	−0.257	−0.260	−1250	2352	0.489	1102	0.229	1142	0.238	− 40	−0.008
Nov.	6.36	6.30	3.61	+0.34	+0.004	2.89	2.94	2.915	2.928	−0.178	−0.174	− 836	2300	0.478	1464	0.305	1078	0.224	386	0.080
Dec.	6.70	7.09	3.39	+0.14	+0.002	2.42	2.75	2.585	2.750	−0.272	−0.270	−1298	*a*2283	0.475	985	0.205	965	0.201	20	0.005

a.—St. Clair River discharge used.

TABLE 25.—Continued. SUPPLY FACTORS OF LAKE MICHIGAN-HURON.

DATE	WATER LEVELS OF DETROIT RIVER. Windmill Point. First of Month.	Windmill Point. Mean of Month.	Amherstburg, Ont., Mean of Month.	STORAGE IN LAKE ST. CLAIR. Foot Depth.	STORAGE IN LAKE ST. CLAIR. Equivalent Foot Depth, Lake Michigan-Huron.	WATER LEVELS OF LAKE MICHIGAN-HURON. Milwaukee Wis., Mean of Month.	Mean, Milwaukee and Harbor Beach, Harbor Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbor Beach, Mean of Month.	Mean, Milwaukee and Harbor Beach, First of Month.	STORAGE IN LAKE MICHIGAN-HURON, Foot Depth.	STORAGE IN LAKE MICHIGAN-HURON AND LAKE ST. CLAIR. Foot Depth, Lake Michigan-Huron.	STORAGE IN LAKE MICHIGAN-HURON AND LAKE ST. CLAIR. 100 c. f. s.	OUTFLOW THROUGH DETROIT RIVER. 100 c. f. s.	OUTFLOW THROUGH DETROIT RIVER. Ft. Depth Lake Michigan-Huron.	TOTAL SUPPLY TO LAKE MICHIGAN-HURON. 100 c. f. s.	TOTAL SUPPLY TO LAKE MICHIGAN-HURON. Foot Depth.	INFLOW FROM ST. MARYS RIVER. 100 c. f. s.	INFLOW FROM ST. MARYS RIVER. Ft. Depth, Lake Michigan-Huron.	LOCAL SUPPLY TO LAKE MICHIGAN-HURON. 100 c. f. s.	LOCAL SUPPLY TO LAKE MICHIGAN-HURON. Foot Depth
1877																					
Jan.	576.84	576.59	572.97	−0.95	−0.011	582.28	582.46	583.37	582.478	−0.108	−0.119	− 572	a2371	0.493	1799	0.374	898	0.187	901	0.187
Feb.	5.89	5.19	2.81	−1.33	−0.015	2.29	2.45	2.37	2.370	−0.018	−0.033	− 159	1947	0.405	1788	0.372	905	0.188	883	0.184
Mar.	4.56	3.94	2.60	−0.12	−0.001	2.29	2.38	2.335	2.352	+0.098	+0.097	+ 466	1342	0.279	1808	0.376	877	0.182	931	0.194
Apr.	4.44	4.94	2.98	+0.66	+0.007	2.67	2.46	2.565	2.450	+0.130	+0.137	+ 659	1753	0.365	2412	0.502	850	0.177	1562	0.325
May	5.10	5.25	3.32	+0.57	+0.006	2.56	2.63	2.595	2.580	+0.022	+0.028	+ 135	1799	0.374	1934	0.402	850	0.177	1084	0.226
June	5.67	6.09	3.39	+0.53	+0.006	2.63	2.59	2.61	2.602	+0.046	+0.052	+ 250	2251	0.468	2501	0.520	900	0.187	1601	0.333
July	6.20	6.30	3.64	+0.06	+0.001	2.60	2.77	2.685	2.648	−0.018	−0.017	− 82	2290	0.476	2208	0.459	976	0.203	1232	0.256
Aug.	6.26	6.22	3.54	−0.18	−0.002	2.48	2.67	2.575	2.630	−0.175	−0.177	− 851	2277	0.474	1426	0.297	1004	0.209	422	0.088
Sept.	6.08	5.94	3.40	−0.20	−0.002	2.27	2.40	2.335	2.455	−0.153	−0.155	− 745	2164	0.450	1419	0.295	949	0.197	470	0.098
Oct.	5.88	5.83	2.99	0.00	0.000	2.28	2.26	2.27	2.302	−0.074	−0.074	− 356	2232	0.464	1876	0.390	958	0.199	918	0.191
Nov.	5.88	5.94	2.78	−0.08	−0.001	2.16	2.21	2.185	2.228	−0.070	−0.071	− 341	1943	0.404	1602	0.333	903	0.188	699	0.145
Dec.	5.80	5.67	2.98	−0.20	−0.002	2.10	2.16	2.13	2.158	−0.083	−0.085	− 409	2149	0.447	1740	0.362	866	0.180	874	0.182
1878																				
Jan.	5.60	5.53	3.04	−0.50	−0.006	1.98	2.06	2.02	2.075	−0.115	−0.121	− 582	2054	0.427	1472	0.306	815	0.170	657	0.137
Feb.	5.10	4.67	3.18	−0.34	−0.004	1.91	1.89	1.90	1.960	+0.022	+0.018	+ 87	1518	0.316	1605	0.334	755	0.157	850	0.177
Mar.	4.76	4.86	3.33	+0.78	+0.009	2.07	2.06	2.065	1.982	+0.070	+0.079	+ 380	1566	0.326	1946	0.405	732	0.152	1214	0.253
Apr.	5.54	6.21	3.70	+0.78	+0.009	2.09	1.99	2.04	2.052	+0.163	+0.172	+ 827	2217	0.461	3044	0.633	728	0.151	2316	0.482
May	6.32	6.43	4.03	+0.14	+0.002	2.39	2.39	2.39	2.215	+0.253	+0.255	+1226	2231	0.464	3457	0.719	792	0.165	2665	0.554
June	6.46	6.49	4.02	+0.07	+0.001	2.53	2.56	2.545	2.468	+0.090	+0.091	+ 437	2271	0.472	2708	0.563	852	0.177	1856	0.386
July	6.53	6.57	4.03	0.00	0.000	2.54	2.60	2.57	2.558	−0.093	−0.093	− 447	2316	0.482	1869	0.389	877	0.182	992	0.206
Aug.	6.53	6.49	3.85	−0.23	−0.003	2.22	2.50	2.36	2.465	−0.227	−0.230	−1106	2330	0.485	1224	0.255	868	0.181	356	0.074
Sept.	6.30	6.12	3.66	−0.30	−0.003	2.02	2.21	2.115	2.238	−0.148	−0.151	− 726	2178	0.453	1452	0.302	801	0.167	651	0.135
Oct.	6.00	5.89	3.30	−0.28	−0.003	1.91	2.22	2.065	2.090	−0.105	−0.108	− 519	2168	0.451	1649	0.343	826	0.172	823	0.171
Nov.	5.72	5.55	2.97	−0.32	−0.004	1.78	2.03	1.905	1.985	−0.210	−0.214	−1029	2088	0.434	1059	0.220	808	0.168	251	0.052
Dec.	5.40	5.25	3.17	−0.37	−0.004	1.46	1.83	1.645	1.775	−0.283	−0.287	−1380	1855	0.386	475	0.099	757	0.157	− 282	−0.059
1879																				
Jan.	5.03	4.81	2.73	−0.53	−0.006	1.15	1.53	1.34	1.492	−0.210	−0.216	−1038	1771	0.368	733	0.152	665	0.138	68	0.014
Feb.	4.50	4.18	2.59	+0.04	0.000	1.16	1.29	1.225	1.282	−0.057	−0.057	− 274	1482	0.308	1208	0.251	573	0.119	635	0.132
Mar.	4.54	4.90	2.64	+0.66	+0.007	1.20	1.25	1.225	1.225	+0.005	+0.012	+ 58	1849	0.385	1907	0.397	518	0.108	1389	0.289
Apr.	5.20	5.49	2.95	+0.26	+0.003	1.19	1.28	1.235	1.230	+0.070	+0.073	+ 351	2062	0.429	2413	0.502	548	0.114	1865	0.388
May	5.46	5.43	3.19	+0.11	+0.001	1.32	1.41	1.365	1.300	+0.118	+0.119	+ 572	1950	0.406	2522	0.525	633	0.132	1889	0.323
June	5.57	5.71	3.27	+0.17	+0.002	1.39	1.55	1.47	1.418	+0.084	+0.086	+ 413	2078	0.432	2491	0.518	665	0.138	1826	0.380
July	5.74	5.78	3.31	−0.06	−0.001	1.48	1.59	1.535	1.502	−0.047	−0.048	− 231	2104	0.438	1873	0.390	734	0.153	1139	0.237
Aug.	5.68	5.58	3.13	−0.21	−0.002	1.29	1.46	1.375	1.455	−0.130	−0.132	− 635	2052	0.427	1417	0.295	741	0.154	767	0.141
Sept.	5.47	5.36	2.74	−0.27	−0.003	1.17	1.38	1.275	1.325	−0.165	−0.168	− 808	2058	0.428	1250	0.260	723	0.150	527	0.110
Oct.	5.20	5.03	2.50	−0.32	−0.004	0.95	1.14	1.045	1.160	−0.200	−0.204	− 981	1961	0.408	980	0.204	730	0.152	250	0.052
Nov.	4.88	4.72	1.90	−0.80	−0.001	0.73	1.02	0.875	0.960	−0.082	−0.083	− 399	1978	0.411	1579	0.328	688	0.143	891	0.185
Dec.	4.80	4.89	2.28	+0.21	+0.002	0.76	1.10	0.88	0.878	+0.024	+0.026	+ 125	1956	0.407	2081	0.433	596	0.124	1485	0.309

1880																			
Jan.	5.01	5.13	2.76	−0.07	−0.001	0.80	1.05	0.925	0.902	−0.014	−0.015	− 72	1931	0.402	1859	0.387	550	0.114	1309	0.272
Feb.	4.94	4.74	2.80	+0.03	0.000	0.71	0.99	0.85	0.888	−0.030	−0.030	− 144	1709	0.356	1565	0.326	543	0.113	1022	0.213
Mar.	4.97	5.20	2.96	+0.33	+0.004	0.75	0.98	0.865	0.858	+0.052	+0.056	+ 269	1903	0.396	2172	0.452	522	0.109	1650	0.343
Apr.	5.30	5.40	3.07	+0.22	+0.002	0.92	0.99	0.955	0.910	+0.230	+0.232	+1115	1974	0.411	3089	0.643	525	0.109	2564	0.533
May	5.52	5.64	3.43	+0.32	+0.004	1.26	1.39	1.325	1.140	+0.435	+0.439	+2110	1983	0.413	4093	0.851	695	0.145	3398	0.707
June	5.84	6.04	3.53	+0.16	+0.002	1.77	1.88	1.825	1.575	+0.383	+0.385	+1851	2176	0.453	4027	0.838	870	0.181	3157	0.657
July	6.00	5.96	3.63	0.00	0.000	1.99	2.19	2.09	1.958	+0.112	+0.112	+ 538	2095	0.436	2633	0.548	926	0.193	1707	0.355
Aug.	6.00	6.05	3.43	−0.09	−0.001	2.02	2.08	2.05	2.070	−0.122	−0.123	− 591	2216	0.461	1625	0.338	898	0.187	727	0.151
Sept.	5.91	5.77	3.14	−0.33	−0.004	1.72	1.97	1.845	1.948	−0.278	−0.282	−1356	2153	0.448	797	0.166	935	0.196	− 138	−0.029
Oct.	5.58	5.39	2.69	−0.28	−0.003	1.38	1.61	1.495	1.670	−0.285	−0.288	−1384	2089	0.435	705	0.147	882	0.183	− 177	−0.037
Nov.	5.30	5.21	2.48	+0.22	+0.002	1.06	1.49	1.275	1.385	−0.203	−0.201	− 966	2058	0.428	1092	0.227	889	0.185	203	0.042
Dec.	5.52	5.82	2.26	−0.50	−0.006	0.89	1.29	1.09	1.182	−0.122	−0.128	− 615	2054	0.427	1439	0.299	824	0.171	615	0.128
1881																				
Jan.	5.02	4.21	1.83	−0.56	−0.006	0.90	1.16	1.03	1.060	+0.120	+0.114	+ 548	1756	0.365	2304	0.479	753	0.157	1551	0.332
Feb.	4.46	4.72	1.94	+0.28	+0.003	1.11	1.55	1.33	1.180	+0.225	+0.228	+1096	1968	0.409	3064	0.637	730	0.152	2334	0.485
Mar.	4.74	4.76	2.28	+0.34	+0.004	1.40	1.56	1.48	1.405	+0.057	+0.061	+ 293	1891	0.393	2184	0.454	734	0.153	1450	0.302
Apr.	5.08	5.41	2.93	+0.53	+0.006	1.31	1.58	1.445	1.462	+0.190	+0.196	+ 942	2025	0.421	2967	0.617	709	0.147	2258	0.470
May	5.61	5.81	3.42	+0.35	+0.004	1.82	1.90	1.86	1.652	+0.308	+0.312	+1500	2083	0.433	3583	0.745	806	0.168	2777	0.577
June	5.96	6.12	3.65	+0.14	+0.002	2.05	2.07	2.06	1.960	+0.130	+0.132	+ 635	2182	0.454	2816	0.586	859	0.179	1957	0.407
July	6.10	6.09	3.61	−0.06	−0.001	2.02	2.22	2.12	2.090	−0.012	−0.013	− 62	2178	0.453	2116	0.440	905	0.188	1211	0.252
Aug.	6.04	5.98	3.33	−0.14	−0.002	2.02	2.05	2.035	2.078	−0.140	−0.142	− 683	2209	0.460	1526	0.317	886	0.184	640	0.133
Sept.	5.90	5.82	2.92	−0.20	−0.002	1.79	1.89	1.84	1.938	+0.047	+0.045	+ 216	2247	0.467	2463	0.512	930	0.193	1533	0.319
Oct.	5.70	5.58	2.86	−0.06	−0.001	2.12	2.14	2.13	1.985	+0.135	+0.134	+ 644	2137	0.445	2781	0.579	1036	0.216	1745	0.353
Nov.	5.64	5.70	2.55	+0.10	+0.001	1.95	2.27	2.11	2.120	−0.078	−0.077	− 370	2288	0.476	1918	0.399	1013	0.211	905	0.188
Dec.	5.74	5.77	2.88	+0.15	+0.002	1.85	2.10	1.975	2.042	−0.160	−0.158	− 760	2232	0.464	1472	0.306	937	0.195	535	0.111
1882																				
Jan.	5.89	6.01	3.33	−0.04	0.000	1.63	1.95	1.79	1.882	−0.152	−0.152	− 731	2225	0.463	1494	0.311	820	0.171	674	0.140
Feb.	5.85	5.69	3.33	+0.11	+0.001	1.62	1.72	1.67	1.730	+0.068	+0.069	+ 332	2045	0.425	2377	0.494	769	0.160	1608	0.335
Mar.	5.96	6.23	3.80	+0.31	+0.003	1.99	1.86	1.925	1.798	+0.214	+0.217	+1043	2194	0.456	3237	0.673	741	0.154	2496	0.519
Apr.	6.27	6.31	3.97	+0.28	+0.003	2.12	2.08	2.10	2.012	+0.156	+0.159	+ 764	2182	0.454	2946	0.613	730	0.152	2216	0.461
May	6.55	6.79	4.26	+0.15	+0.002	2.22	2.25	2.235	2.168	+0.192	+0.194	+ 933	2368	0.493	3301	0.687	824	0.171	2477	0.515
June	6.70	6.62	4.40	+0.20	+0.002	2.49	2.48	2.485	2.360	+0.192	+0.194	+ 933	2206	0.459	3139	0.653	845	0.176	2294	0.477
July	6.90	7.18	4.34	+0.28	+0.003	2.62	2.62	2.62	2.552	+0.130	+0.133	+ 639	2580	0.537	3219	0.670	926	0.193	2293	0.477
Aug.	7.18	7.18	4.24	−0.34	−0.004	2.81	2.68	2.745	2.682	+0.003	−0.001	− 5	2615	0.544	2610	0.543	949	0.197	1661	0.346
Sept.	6.84	6.51	3.91	−0.50	−0.006	2.69	2.56	2.625	2.685	−0.220	−0.226	−1086	2321	0.483	1235	0.257	935	0.195	300	0.062
Oct.	6.34	6.16	3.45	−0.32	−0.004	2.28	2.33	2.305	2.465	−0.275	−0.279	−1341	2271	0.472	930	0.193	914	0.190	16	0.003
Nov.	6.02	5.87	3.00	+0.07	+0.001	2.07	2.08	2.075	2.190	−0.235	−0.234	−1125	2251	0.468	1126	0.234	900	0.187	226	0.047
Dec.	6.09	6.31	2.61	+0.01	0.000	1.74	1.93	1.835	1.955	−0.235	−0.235	−1130	a2139	0.445	1009	0.210	838	0.174	171	0.036
1883																				
Jan.	6.10	5.89	2.50	−0.32	−0.004	1.48	1.73	1.605	1.720	−0.118	−0.122	− 586	a2238	0.466	1652	0.344	739	0.154	913	0.190
Feb.	5.78	5.67	2.71	−0.40	−0.004	1.52	1.68	1.60	1.602	+0.030	+0.026	+ 125	2228	0.463	2353	0.489	718	0.149	1635	0.340
Mar.	5.38	5.09	2.92	+0.01	0.000	1.61	1.72	1.665	1.632	+0.088	+0.088	+ 423	1856	0.386	2279	0.474	718	0.149	1561	0.325
Apr.	5.39	5.69	2.99	+0.53	+0.006	1.82	1.73	1.775	1.720	+0.318	+0.324	+1557	2156	0.449	3713	0.772	734	0.153	2979	0.620
May	5.92	6.14	3.54	+0.59	+0.007	2.30	2.30	2.30	2.038	+0.457	+0.464	+2230	2230	0.464	4460	0.928	732	0.152	3728	0.776
June	6.51	6.88	4.23	+0.69	+0.008	2.66	2.72	2.69	2.495	+0.465	+0.473	+2274	2434	0.506	4708	0.979	817	0.170	3891	0.809
July	7.20	7.51	4.44	+0.28	+0.003	3.26	3.20	3.23	2.960	+0.312	+0.315	+1524	2754	0.573	4268	0.888	859	0.179	3409	0.709
Aug.	7.48	7.44	4.42	−0.28	−0.003	3.23	3.40	3.315	3.272	−0.084	−0.087	− 418	2716	0.565	2298	0.478	956	0.199	1342	0.279
Sept.	7.20	6.95	4.05	−0.46	−0.005	3.04	3.08	3.06	3.188	−0.266	−0.271	−1303	2538	0.528	1235	0.257	880	0.183	355	0.074
Oct.	6.74	6.54	3.72	−0.42	−0.005	2.82	2.75	2.785	2.922	−0.222	−0.227	−1091	2402	0.500	1311	0.273	845	0.176	466	0.097
Nov.	6.32	6.09	3.21	−0.28	−0.003	2.37	2.86	2.615	2.700	−0.132	−0.135	− 649	2307	0.480	1658	0.345	820	0.171	838	0.174
Dec.	6.04	6.00	3.36	−0.77	−0.009	2.29	2.75	2.52	2.568	−0.150	−0.159	− 764	2211	0.460	1447	0.301	760	0.158	687	0.143

a.—St. Clair River discharge used.

TABLE 25.—Continued. SUPPLY FACTORS OF LAKE MICHIGAN–HURON.

DATE	WATER LEVELS OF DETROIT RIVER. Windmill Point. First of Month.	Windmill Point. Mean of Month.	Amherstburg, Ont., Mean of Month.	STORAGE IN LAKE ST. CLAIR. Foot Depth.	STORAGE IN LAKE ST. CLAIR. Equivalent Foot Depth, Lake Michigan-Huron.	WATER LEVELS OF LAKE MICHIGAN-HURON. Milwaukee Wis., Mean of Month.	Harbor Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbor Beach. Mean of Month.	Mean, Milwaukee and Harbor Beach. First of Month.	STORAGE IN LAKE MICHIGAN-HURON, Foot Depth.	STORAGE IN LAKE MICHIGAN-HURON AND LAKE ST. CLAIR. Foot Depth, Lake Michigan-Huron.	STORAGE IN LAKE MICHIGAN-HURON AND LAKE ST. CLAIR. 100 c. f. s.	OUTFLOW THROUGH DETROIT RIVER. 100 c. f. s.	OUTFLOW THROUGH DETROIT RIVER. Ft. Depth Lake Michigan-Huron.	TOTAL SUPPLY TO LAKE MICHIGAN-HURON. 100 c. f. s.	TOTAL SUPPLY TO LAKE MICHIGAN-HURON. Foot Depth.	INFLOW FROM ST. MARYS RIVER. 100 c. f. s.	INFLOW FROM ST. MARYS RIVER. Ft. Depth Lake Michigan-Huron.	LOCAL SUPPLY TO LAKE MICHIGAN-HURON. 100 c. f. s.	LOCAL SUPPLY TO LAKE MICHIGAN-HURON. Foot Depth
1884																				
Jan.	575.27	574.54	573.01	−0.47	−0.005	582.07	582.56	582.315	582.418	−0.110	−0.115	− 553	1514	0.315	961	0.200	737	0.153	224	0.047
Feb.	4.80	5.05	3.27	+0.95	+0.011	2.19	2.41	2.30	2.308	+0.064	+0.075	+ 361	1703	0.354	2064	0.429	693	0.144	1371	0.285
Mar.	5.75	6.45	3.48	+0.84	+0.009	2.44	2.45	2.445	2.372	+0.196	+0.205	+ 985	2426	0.505	3411	0.710	672	0.140	2739	0.570
Apr.	6.59	6.73	3.98	+0.25	+0.003	2.62	2.76	2.69	2.568	+0.230	+0.233	+1120	2428	0.505	3548	0.738	633	0.132	2915	0.066
May	6.84	6.96	4.34	+0.21	+0.002	2.83	2.98	2.905	2.798	+0.162	+0.164	+ 788	2444	0.508	3232	0.672	718	0.149	2514	0.523
June	7.05	7.14	4.41	+0.09	+0.001	2.99	3.04	3.015	2.960	+0.035	+0.036	+ 173	2531	0.527	2704	0.563	741	0.154	1963	0.408
July	7.14	7.15	4.20	−0.13	−0.001	2.83	3.12	2.975	2.995	−0.085	−0.086	− 413	2611	0.543	2198	0.457	792	0.165	1406	0.292
Aug.	7.01	6.87	4.08	−0.33	−0.004	2.69	3.00	2.845	2.910	−0.215	−0.219	−1053	2489	0.518	1436	0.299	801	0.167	635	0.132
Sept.	6.68	6.48	3.59	−0.33	−0.004	2.44	2.65	2.545	2.695	−0.110	−0.114	− 548	2410	0.501	1862	0.387	817	0.170	1045	0.217
Oct.	6.35	6.22	3.25	−0.32	−0.004	2.44	2.81	2.625	2.585	−0.137	−0.141	− 678	2367	0.492	1689	0.351	838	p.174	851	0.177
Nov.	6.03	5.84	2.64	−0.13	−0.001	2.08	2.46	2.27	2.448	−0.250	−0.251	−1207	2336	0.486	1129	0.235	861	0.179	268	0.056
Dec.	5.90	5.96	2.69	+0.30	+0.003	2.05	2.20	2.125	2.198	−0.003	0.000	0	2384	0.496	2384	0.496	801	0.167	1583	0.329
1885																				
Jan.	6.20	6.43	2.49	−0.14	−0.002	2.06	2.47	2.265	2.195	+0.105	+0.103	+ 495	a2398	0.499	2893	0.602	762	0.159	2131	0.443
Feb.	6.06	5.69	2.28	+0.06	+0.001	2.29	2.38	2.335	2.300	+0.025	+0.026	+ 125	2352	0.489	2477	0.515	737	0.153	1740	0.362
Mar.	6.12	6.56	2.16	+0.47	+0.005	2.25	2.38	2.315	2.325	+0.065	+0.070	+ 336	a2364	0.492	2700	0.562	704	0.146	1996	0.415
Apr.	6.59	6.62	2.93	−0.01	0.000	2.44	2.49	2.465	2.390	+0.265	+0.265	+1274	a2287	0.476	3561	0.741	665	0.138	2896	0.602
May	6.58	6.53	3.75	+0.14	+0.002	2.80	2.89	2.845	2.655	+0.315	+0.317	+1524	2386	0.496	3910	0.813	799	0.166	3111	0.647
June	6.72	6.91	4.25	+0.12	+0.001	3.01	3.18	3.095	2.970	+0.162	+0.163	+ 784	2445	0.509	3229	0.672	877	0.182	2352	0.489
July	6.84	6.78	4.22	0.00	0.000	3.10	3.24	3.17	3.132	+0.128	+0.128	+ 615	2376	0.494	2991	0.622	919	0.191	2072	0.431
Aug.	6.84	6.90	4.27	−0.03	0.000	3.31	3.39	3.35	3.260	+0.030	+0.030	+ 144	2432	0.506	2576	0.536	969	0.202	1607	0.334
Sept.	6.81	6.72	4.06	−0.27	−0.003	3.17	3.29	3.23	3.290	−0.152	−0.155	− 745	2396	0.498	1651	0.343	914	0.190	737	0.153
Oct.	6.54	6.36	3.95	−0.20	−0.002	3.03	3.06	3.045	3.138	−0.216	−0.218	−1048	2217	0.461	1169	0.243	873	0.182	296	0.062
Nov.	6.34	6.31	3.70	−0.07	−0.001	2.73	2.87	2.80	2.922	−0.244	−0.245	−1178	2276	0.473	1098	0.228	856	0.178	242	0.050
Dec.	6.27	6.23	3.77	−0.47	−0.005	2.44	2.67	2.555	2.678	−0.066	−0.071	− 341	2204	0.458	1863	0.388	787	0.164	1076	0.224
1886																				
Jan.	5.80	5.36	3.77	−0.86	−0.010	2.67	2.67	2.67	2.612	+0.080	+0.070	+ 336	1677	0.349	2013	0.419	707	0.147	1306	0.272
Feb.	4.94	4.53	3.04	0.00	0.000	2.69	2.74	2.715	2.692	+0.140	+0.140	+ 673	1490	0.310	2163	0.450	670	0.139	1493	0.311
Mar.	4.94	5.34	2.87	+0.75	+0.008	2.97	2.93	2.95	2.832	+0.258	+0.266	+1279	2008	0.418	3287	0.684	670	0.139	2617	0.544
Apr.	5.69	6.04	3.70	+0.73	+0.008	3.24	3.22	3.23	3.090	+0.288	+0.296	+1423	2118	0.441	3541	0.737	665	0.138	2876	0.598
May	6.42	6.79	4.09	+0.40	+0.004	3.50	3.55	3.525	3.378	+0.187	+0.191	+ 918	2428	0.505	3346	0.696	776	0.161	2570	0.535
June	6.82	6.85	4.18	+0.02	0.000	3.57	3.64	3.605	3.565	−0.047	−0.047	− 226	2432	0.506	2206	0.459	813	0.169	1393	0.290
July	6.84	6.82	4.17	−0.08	−0.001	3.38	3.48	3.43	3.518	−0.183	−0.184	− 884	2418	0.503	1534	0.319	852	0.177	682	0.142
Aug.	6.76	6.71	4.01	−0.14	−0.002	3.15	3.33	3.24	3.335	−0.200	−0.202	− 971	2406	0.501	1435	0.299	884	0.184	551	0.115
Sept.	6.62	6.53	3.70	−0.19	−0.002	2.91	3.15	3.03	3.135	−0.163	−0.165	− 793	2403	0.500	1610	0.335	852	0.177	758	0.158
Oct.	6.43	6.33	3.46	−0.27	−0.003	2.81	3.02	2.915	2.972	−0.210	−0.213	−1024	2364	0.492	1340	0.279	859	0.179	481	0.100
Nov.	6.16	5.98	3.04	−0.08	−0.001	2.47	2.75	2.61	2.762	−0.314	−0.315	−1514	2298	0.478	784	0.163	843	0.175	− 59	−0.012
Dec.	6.08	6.19	3.07	−0.06	−0.001	2.14	2.43	2.285	2.448	−0.226	−0.227	−1091	2403	0.500	1312	0.273	744	0.155	568	0.118

1887																				
Jan.	6 02	5 85	2 83	−0 08	−0 001	2 06	2 26	2 16	2 222	+0 078	+0.077	+ 370	2289	0.476	2659	0.553	693	0.144	1966	0.409
Feb.	5 94	6 02	3 26	+0 10	+0.001	2 43	2 15	2 11	2 300	+0 232	+0.233	+1120	2253	0 169	3373	0 702	661	0 138	2712	0.564
Mar.	6 04	6 05	4 06	+0 13	+0 001	2 59	2 66	2 625	2 532	+0 058	+0.059	+ 284	1985	0 113	2269	0 472	651	0 136	1615	0.336
April	6 17	6 29	4 06	+0 26	+0 003	2 54	2 57	2 555	2 590	+0 065	+0 068	+ 327	2133	0 144	2460	0 512	622	0 129	1838	0.382
May	6 43	6 57	4 33	+0 19	+0 002	2 71	2 77	2 755	2.655	+0 163	+0.165	+ 793	2202	0 158	2995	0 623	704	0 146	2291	0.477
June	6 62	6 67	4 34	+0 03	0.000	2 87	2 89	2 88	2 818	+0 067	+0 067	+ 322	2261	0 170	2583	0 537	808	0 168	1775	0.369
July	6 65	6 63	4 12	−0 11	−0.001	2 81	2 97	2 89	2 885	−0 083	−0 084	− 404	2319	0 482	1915	0 398	893	0 186	1022	0.213
Aug.	6 54	6 46	3 85	−0 24	−0.003	2 67	2 76	2 715	2 802	−0 260	−0.263	−1264	2316	0 482	1052	0 219	866	0 180	186	0.039
Sept.	6 30	6 15	3 55	−0 34	−0.004	2 33	2 41	2 37	2 542	−0 340	−0.344	−1654	2233	0 465	579	0 120	834	0 173	− 255	−0.053
Oct.	5 96	5 78	2 95	−0 40	−0.004	1 88	2 19	2 035	2 202	−0 362	−0.366	−1759	2217	0 461	458	0 095	875	0 182	− 417	−0.087
Nov.	5 56	5 35	2 55	−0 26	−0.003	1 55	1 74	1 645	1 840	−0 298	−0.301	−1447	2109	0 439	662	0 138	822	0 171	− 160	−0.033
Dec.	5 30	5 25	2 69	−0 04	0 000	1 43	1 45	1 44	1 542	−0 174	−0.174	− 836	2016	0 419	1180	0 245	728	0 151	452	0.094
1888																				
Jan.	5 26	5 28	2 49	−0 06	−0.001	1 25	1 34	1 295	1 368	−0 108	−0.109	− 524	2090	0 435	1566	0 326	691	0 144	875	0.182
Feb.	5 20	5 12	2 22	−0 21	−0.002	1 20	1 25	1 225	1 260	+0 052	+0.050	+ 240	2086	0 434	2326	0 484	612	0 127	1714	0.357
Mar.	4 99	4 86	2 34	+0 21	+0.002	1 38	1 42	1 40	1 312	+0 176	+0.178	+ 856	1922	0 400	2778	0 578	624	0 130	2154	0.448
April	5 20	5 55	2 92	+0 39	+0.004	1 59	1 56	1 575	1 488	+0 292	+0 296	+1423	2104	0 438	3527	0 734	622	0 129	2905	0.604
May	5 59	5 63	3 26	+0 15	+0.002	1 97	2 00	1 985	1 780	+0 348	+0.350	+1682	2036	0 424	3718	0 773	760	0 158	2958	0.615
June	5 74	5 85	3 38	+0 24	+0.003	2 24	2 30	2 27	2 128	+0 152	+0.155	+ 745	2120	0 441	2865	0 596	956	0 199	1909	0.397
July	5 98	6 10	3 54	+0 08	+0.001	2 25	2 33	2 29	2 280	−0 010	−0.009	− 43	2208	0 459	2165	0 450	992	0 206	1173	0.244
Aug.	6 06	6 01	3 48	−0 18	−0 002	2 13	2 37	2 25	2 270	−0 130	−0.132	− 635	2177	0 453	1542	0 321	990	0 206	552	0.115
Sept.	5 88	5 74	2 98	−0 30	−0.003	1 98	2 08	2 03	2 140	−0 248	−0.251	−1207	2186	0 455	979	0 204	972	0 202	7	0.001
Oct.	5 58	5 42	2 60	−0 23	−0.003	1 73	1 78	1 755	1 892	−0 194	−0.197	− 947	2131	0 443	1184	0 246	969	0 202	215	0.045
Nov.	5 35	5 28	2 53	−0 15	−0.002	1 68	1 60	1 64	1 698	−0 256	−0.258	−1240	2079	0 432	839	0 175	923	0 192	− 84	−0.017
Dec.	5 20	5 11	2 53	+0 02	0.000	1 10	1 39	1 245	1 442	−0 237	−0 237	−1139	1992	0 414	853	0 177	778	0 162	75	0.016
1889																				
Jan.	5 22	5 32	2 53	−0 34	−0.004	1 08	1 25	1 165	1 205	−0 067	−0.071	− 341	2099	0 437	1758	0 366	722	0 150	1036	0.216
Feb.	4 88	4 44	2 37	−0 47	−0 005	1 05	1 17	1 11	1 138	−0 038	−0.043	− 207	1701	0 354	1494	0 311	664	0 138	830	0.173
Mar.	4 41	4 38	2 23	+0 14	+0 002	1 03	1 15	1 09	1 100	−0 025	−0.023	− 111	1716	0 357	1605	0 334	670	0 139	935	0.195
April	4 55	4 72	2 53	+0 39	+0.004	1 04	1 08	1 06	1 075	+0 040	+0.044	+ 212	1792	0 373	2004	0 417	668	0 139	1336	0.278
May	4 94	5 16	2 80	+0 50	+0 006	1 12	1 22	1 17	1 115	+0 253	+0.259	+1245	1934	0 402	3179	0 661	780	0 162	2399	0.499
June	5 44	5 72	3 22	+0 33	+0.004	1 58	1 55	1 565	1 368	+0 307	+0.311	+1495	2100	0 437	3595	0 748	816	0 170	2779	0.578
July	5 77	5 82	3 43	−0 02	0 000	1 76	1 81	1 785	1 675	+0 035	+0.035	+ 168	2086	0 434	2254	0 469	870	0 181	1384	0.288
Aug.	5 75	5 68	3 16	−0 19	−0 002	1 52	1 75	1 635	1 710	−0 160	−0 162	− 779	2097	0 436	1318	0 274	872	0 181	446	0.093
Sept.	5 56	5 45	2,71	−0 32	−0 004	1 35	1 58	1 465	1 550	−0 240	−0.244	−1173	2113	0 440	940	0 196	870	0 181	70	0.015
Oct.	5 24	5 02	2 28	−0 36	−0 004	1 10	1 21	1 155	1 310	−0 328	−0.332	−1596	2020	0 420	424	0 088	840	0 175	− 416	−0.087
Nov.	4 88	4 73	1 88	−0 22	−0 002	0 75	0 87	0 81	0 982	−0 257	−0 259	−1245	1988	0 414	743	0 155	780	0 162	− 37	−0.008
Dec.	4 66	4 60	2 26	+0 16	+0 002	0 57	0 71	0 64	0 725	−0 047	−0 045	− 216	1817	0 378	1601	0 333	704	0 146	897	0 187
1890																				
Jan.	4 82	5 05	2 60	+0 18	+0.002	0 65	0 78	0 715	0 678	−0 003	−0.001	− 5	1940	0 404	1935	0 403	714	0 149	1221	0.254
Feb.	5 00	4 96	2 89	−0 04	0 000	0 61	0 66	0 635	0 675	−0 050	−0.050	− 240	1797	0 374	1557	0 324	604	0 126	953	0.198
Mar.	4 96	4 96	3 03	+0 22	+0.002	0 59	0 64	0 615	0 625	+0 105	+0.107	+ 514	1745	0 363	2259	0 470	602	0 125	1657	0.345
April	5 18	5 39	3 47	+0 37	+0.004	0 91	0 78	0 845	0 730	+0 250	+0 254	+1221	1823	0 379	3044	0 633	588	0 122	2456	0.511
May	5 55	5 71	3 90	+0 38	+0 004	1 14	1 09	1 115	0 980	+0 345	+0 349	+1678	1829	0 383	3517	0 732	682	0 142	2835	0.590
June	5 93	6 15	4 26	+0 17	+0.002	1 55	1 52	1 535	1 325	+0 275	+0.277	+1332	1964	0 409	3296	0 686	798	0 166	2498	0.520
July	6 10	6 04	3 89	−0 18	−0.002	1 62	1 71	1 665	1 600	+0 045	+0 043	+ 207	2046	0 426	2253	0 469	870	0 181	1383	0.288
Aug.	5 92	5 81	3 47	−0 24	−0.003	1 54	1 71	1 625	1 6 5	−0 137	−0 140	− 673	2066	0 430	1393	0 290	852	0 177	541	0.113
Sept.	5 68	5 54	3 24	−0 27	−0 003	1 34	1 44	1 39	1 508	−0 198	−0 201	− 966	1994	0 415	1028	0 214	830	0 173	198	0.041
Oct.	5 41	5 28	3 04	−0 15	−0.002	1 23	1 23	1 23	1 310	−0 215	−0 217	−1043	1919	0 399	876	0 182	816	0 170	60	0.012
Nov.	5 26	5 24	2 88	−0 12	−0.001	0 89	1 03	0 96	1 095	−0 297	−0 298	−1432	1950	0 406	518	0 108	788	0 164	− 270	−0.056
Dec.	5 14	5 03	2 77	−0 34	−0 004	0 54	0 73	0 635	0 798	−0 218	−0 222	−1067	1875	0 390	808	0 168	728	0 151	80	0 017

a.—St. Clair River discharge used.

TABLE 25.—Continued. SUPPLY FACTORS OF LAKE MICHIGAN HURON.

DATE	WATER LEVELS OF DETROIT RIVER. Windmill Point. First of Month.	Windmill Point. Mean of Month.	Amherstburg, Ont., Mean of Month.	STORAGE IN LAKE ST. CLAIR. Foot Depth.	Equivalent Foot Depth, Lake Michigan-Huron.	WATER LEVELS OF LAKE MICHIGAN-HURON. Milwaukee Wis., Mean of Month.	Harbor Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbor Beach Mean of Month.	Mean, Milwaukee and Harbor Beach First of Month.	STORAGE IN LAKE MICHIGAN-HURON, Foot Depth.	STORAGE IN LAKE MICHIGAN-HURON AND LAKE ST. CLAIR. Foot Depth, Lake Michigan-Huron.	100 c. f. s.	OUTFLOW THROUGH DETROIT RIVER. 100 c. f. s.	Ft. Depth Lake Michigan-Huron.	TOTAL SUPPLY TO LAKE MICHIGAN-HURON. 100 c. f. s.	Foot Depth.	INFLOW FROM ST. MARYS RIVER. 100 c. f. s.	Ft. Depth Lake Michigan-Huron.	LOCAL SUPPLY TO LAKE MICHIGAN-HURON. 100 c. f. s.	Foot Depth
1891																					
Jan.	574 80	574 58	572 53	−0.14	−0.002	580 52	580 53	580.525	580.580	−0.142	−0.144	− 692	1718	0.357	1026	0.213	590	0.123	436	0.091
Feb.	4.66	4.74	2.51	−0.01	0.000	0.28	0.42	0.35	0.438	−0.048	−0.048	− 231	1809	0.376	1579	0.328	612	0.127	966	0.201
Mar.	4.65	4.56	2.99	+0.11	+0.001	0.47	0.39	0.43	0.390	+0.200	+0.201	+ 966	1534	0.319	2500	0.520	582	0.121	1918	0.399
April	4.76	4.97	2.81	+0.22	+0.002	0.78	0.72	0.75	0.590	+0.245	+0.247	+1187	1830	0.381	3017	0.628	618	0.129	2399	0.499
May	4.98	4.98	2.72	+0.06	+0.001	0.88	0.96	0.92	0.835	+0.110	+0.111	+ 534	1865	0.388	2399	0.499	704	0.146	1695	0.353
June	5.04	5.10	2.85	+0.08	+0.001	1.03	0.91	0.97	0.945	−0.010	−0.009	− 43	1885	0.392	1842	0.383	694	0.144	1148	0.239
July	5.12	5.13	2.76	−0.04	0.000	0.86	0.94	0.90	0.935	−0.077	−0.077	− 370	1931	0.402	1561	0.325	716	0.149	845	0.176
Aug.	5.08	5.03	2.53	−0.13	−0.001	0.79	0.84	0.815	0.858	−0.148	−0.149	− 716	1952	0.406	1236	0.257	718	0.149	518	0.108
Sept.	4.95	4.87	2.29	−0.26	−0.003	0.56	0.65	0.605	0.710	−0.288	−0.291	−1399	1943	0.404	544	0.113	704	0.146	− 160	−0.033
Oct.	4.69	4.51	1.90	−0.31	−0.003	0.20	0.28	0.24	0.422	−0.360	−0.363	−1745	1878	0.391	133	0.028	716	0.149	− 583	−0.121
Nov.	4.38	4.26	1.33	−0.11	−0.001	579.80	579.97	579.885	0.062	−0.207	−0 208	−1000	1912	0.398	912	0.190	694	0.144	218	0.045
Dec.	4.27	4.28	1.52	−0.19	−0.002	9.74	9 91	9.825	579.855	+0.005	+0.003	+ 14	1873	0.390	1887	0.393	632	0.131	1255	0.261
1892																					
Jan.	4.08	3.87	1.53	−0.56	−0.006	9.86	9.93	9.895	9.860	+0.068	+0.062	+ 298	1683	0.350	1981	0.412	620	0.129	1361	0.283
Feb.	3.52	3.18	1.32	−0.23	−0.003	580.05	9.87	9.96	9.928	+0.022	+0.019	+ 91	1425	0.296	1516	0.315	548	0.114	968	0.201
Mar.	3.29	3.40	1.38	+0.55	+0.006	579.95	9.93	9.94	9.950	+0.035	+0.041	+ 197	1508	0.314	1705	0.355	512	0.107	1193	0.248
April	3.84	4.27	1.89	+0.73	+0.008	580.01	580.05	580.03	9.985	+0.173	+0.181	+ 870	1767	0.368	2637	0.549	544	0.113	2093	0.435
May	4.57	4.87	2.78	+0.61	+0.007	0.43	0.14	0.285	580.158	+0.372	+0.379	+1822	1787	0.372	3609	0.751	646	0.134	2963	0.616
June	5.18	5.50	3.53	+0.40	+0.004	0.88	0.67	0.075	0.530	+0.320	+0.324	+1557	1864	0.388	3421	0.712	718	0.149	2703	0.562
July	5.58	5.66	3.66	0.00	0.000	0.89	0.96	0.925	0.850	+0.115	+0.115	+ 553	1908	0.397	2461	0.512	746	0.155	1715	0.357
Aug.	5.58	5.49	3.35	−0.16	−0.002	0.97	1.04	1.005	0.965	−0.053	−0.055	− 264	1926	0.401	1662	0.346	748	0.156	914	0.190
Sept.	5.42	5.35	2.97	−0.32	−0.004	0.77	0.87	0.82	0.912	−0.204	−0.208	−1000	1981	0.412	981	0.204	760	0.158	221	0.046
Oct.	5.10	4.86	2.40	−0.44	−0.005	0.53	0.66	0.595	0.708	−0.263	−0.268	−1288	1905	0.396	617	0.128	738	0.154	− 121	−0.025
Nov.	4.66	4.46	1.94	−0.34	−0.004	0.26	0.33	0.295	0.445	−0.277	−0.281	−1351	1843	0.383	492	0.102	682	0.142	− 190	−0.040
Dec.	4.32	4.18	1.79	−0.58	−0.006	579.99	0.09	0.04	0.168	−0.193	−0.199	− 957	1753	0.365	796	0.166	626	0.130	170	0.035
1893																					
Jan.	3.74	3.31	1.39	−0.35	−0.004	9.98	579.84	579.91	579.975	−0.043	−0.047	− 226	1464	0.304	1238	0.258	519	0.108	719	0.150
Feb.	3.39	3.47	1.47	+0.51	+0.006	580.12	9.79	9.955	9.932	+0.070	+0.076	+ 365	1514	0.315	1879	0.391	482	0.100	1397	0.291
Mar.	3.90	4.34	1.71	+0.68	+0.008	0.23	9.87	580.05	580.002	+0.258	+0.266	+1279	1851	0.385	3130	0.651	484	0.101	2646	0.550
April	4.58	4.81	2.39	+0.46	+0.005	0.69	580.25	0.47	0.260	+0.442	+0.447	+2149	1883	0.392	4032	0.839	531	0.110	3501	0.728
May	5.04	5.28	3.32	+0 42	+0.005	0.99	0.88	0.935	0.702	+0.398	+0.403	+1937	1817	0.378	3754	0.886	638	0.133	3116	0.648
June	5.46	5.63	3 50	+0.17	+0.002	1.32	1.21	1.265	1.100	+0.205	+0.207	+ 995	1950	0.406	2945	0.613	738	0.153	2207	0.459
July	5.63	5 63	3.23	−0.09	−0.001	1.34	1.35	1 345	1.305	−0.037	−0.038	− 183	2047	0.426	1864	0.388	775	0.161	1089	0.227
Aug.	5.54	5 46	2 93	−0 22	−0.002	1.17	1 21	1.19	1 268	−0.233	−0.235	−1130	2052	0 427	922	0.192	790	0 164	132	0.027
Sept.	5.32	5.17	2 49	−0 30	−0 003	0 85	0 91	0 88	1 035	−0.235	−0.248	−1192	2034	0.423	842	0.175	766	0.159	76	0.016
Oct.	5.02	4.87	2.13	−0 30	−0 003	0 71	0.73	0.72	0 800	−0 242	−0.245	−1178	1988	0 414	810	0.169	755	0.157	55	0.011
Nov.	4.72	4.58	1.60	−0.12	−0.001	0.32	0.47	0.395	0.558	−0.228	−0.229	−1062	1990	0.414	928	0.193	745	0.155	183	0.038
Dec.	4.60	4.62	1.80	+0.01	0.000	0.25	0.28	0.265	0.330	−0.075	−0.075	− 361	1958	0.407	1597	0.332	644	0.134	953	0.198

1894																			
Jan.	4.61	4.60	2.06	−0.23	−0.003	0.26	0.23	0.245	0.255	0.000	−0.003	− 14	1876	0.390	1862	0.387	602	0.125	1260	0.262
Feb.	4.38	4.16	1.94	−0.02	0.000	0.29	0.24	0.265	0.255	+0.113	+0.113	+ 543	1698	0.353	2241	0.466	587	0.122	1654	0.344
Mar.	4.36	4.56	1.99	+0.30	+0.003	0.55	0.39	0.47	0.368	+0.197	+0.200	+ 961	1877	0.390	2838	0.590	566	0.118	2272	0.473
April	4.66	4.75	2.34	+0.34	+0.004	0.70	0.62	0.66	0.565	+0.330	+0.334	+1606	1867	0.388	3475	0.722	638	0.133	2835	0.590
May	5.00	5.26	2.82	+0.38	+0.004	1.24	1.02	1.13	0.895	+0.350	+0.354	+1702	1981	0.412	3683	0.766	822	0.171	2861	0.595
June	5.38	5.50	3.02	+0.12	+0.001	1.40	1.32	1.36	1.245	+0.160	+0.161	+ 774	2045	0.425	2819	0.586	868	0.181	1951	0.406
July	5.50	5.50	3.01	−0.10	−0.001	1.43	1.47	1.45	1.405	−0.043	−0.044	− 212	2048	0.426	1836	0.382	894	0.186	942	0.196
Aug.	5.40	5.31	2.68	−0.18	−0.002	1.35	1.20	1.275	1.362	−0.242	−0.244	−1173	2051	0.427	878	0.183	896	0.186	− 18	−0.004
Sept.	5.22	5.13	2.45	−0.24	−0.003	0.92	1.01	0.965	1.120	−0.268	−0.271	−1303	2026	0.421	723	0.150	871	0.181	− 148	−0.031
Oct.	4.98	4.83	2.12	−0.28	−0.003	0.71	0.77	0.74	0.852	−0.227	−0.230	−1106	1971	0.410	865	0.180	879	0.183	− 14	−0.003
Nov.	4.70	4.58	1.75	−0.18	−0.002	0.44	0.58	0.51	0.625	−0.277	−0.279	−1341	1952	0.406	611	0.127	860	0.179	− 249	−0.052
Dec.	4.52	4.46	1.80	+0.16	+0.002	0.09	0.28	0.185	0.348	−0.288	−0.286	−1375	1882	0.392	507	0.105	804	0.167	− 297	−0.062
1895																				
Jan.	4.68	4.89	1.45	+0.24	+0.003	579.91	579.96	579.935	0.060	−0.182	−0.179	− 860	*a*1878	0.391	1018	0.212	747	0.155	271	0.056
Feb.	4.92	4.96	1.22	−0.24	−0.003	9.80	9.84	9.82	579.878	−0.063	−0.066	− 317	*a*1842	0.383	1525	0.317	721	0.150	804	0.167
Mar.	4.68	4.39	1.25	−0.52	−0.006	9.77	9.85	9.81	9.815	+0.070	+0.064	+ 308	1988	0.414	2296	0.478	683	0.142	1613	0.336
April	4.16	3.93	1.45	−0.05	−0.001	9.97	9.95	9.96	9.885	+0.157	+0.156	+ 750	1732	0.360	2482	0.516	679	0.141	1803	0.375
May	4.11	4.29	1.76	+0.25	+0.003	580.13	580.12	580.125	580.042	+0.113	+0.116	+ 558	1814	0.377	2372	0.493	755	0.157	1617	0.336
June	4.36	4.44	1.84	+0.09	+0.001	0.18	0.19	0.185	0.155	−0.005	−0.004	− 19	1861	0.387	1842	0.383	828	0.172	1014	0.211
July	4.45	4.46	1.74	−0.01	0.000	0.07	0.16	0.115	0.150	−0.088	−0.088	− 423	1898	0.395	1475	0.307	873	0.182	602	0.125
Aug.	4.44	4.43	1.70	−0.08	−0.001	579.95	0.07	0.01	0.062	−0.152	−0.153	− 735	1895	0.394	1160	0.241	875	0.182	285	0.059
Sept.	4.36	4.28	1.54	−0.30	−0.003	9.68	579.94	579.81	579.910	−0.265	−0.268	−1288	1868	0.389	580	0.121	907	0.189	− 327	−0.068
Oct.	4.06	3.84	1.05	−0.37	−0.004	9.31	9.65	9.48	9.645	−0.317	−0.321	−1543	1794	0.373	251	0.052	930	0.193	− 679	−0.141
Nov.	3.69	3.54	0.82	−0.04	0.000	9.09	9.26	9.175	9.328	−0.240	−0.240	−1154	1722	0.358	568	0.118	832	0.173	− 264	−0.055
Dec.	3.65	3.76	1.10	+0.12	+0.001	8.98	9.02	9.00	9.088	−0.050	−0.049	− 236	1748	0.364	1512	0.315	830	0.173	682	0.142
1896																				
Jan.	3.77	3.78	1.18	−0.38	−0.004	9.06	9.09	9.075	9.038	+0.077	+0.073	+ 351	1736	0.361	2087	0.434	727	0.151	1360	0.283
Feb.	3.39	3.00	1.10	−0.25	−0.003	9.10	9.21	9.155	9.115	+0.017	+0.014	+ 67	1410	0.293	1477	0.307	687	0.143	790	0.164
Mar.	3.14	3.27	1.07	+0.41	+0.005	9.11	9.11	9.11	9.132	+0.030	+0.035	+ 168	1540	0.320	1708	0.355	649	0.135	1059	0.220
April	3.55	3.83	1.47	+0.43	+0.005	9.29	9.14	9.215	9.162	+0.223	+0.228	+1096	1681	0.350	2777	0.578	701	0.146	2076	0.432
May	3.98	4.14	1.94	+0.34	+0.004	9.57	9.54	9.555	9.385	+0.343	+0.347	+1668	1688	0.351	3356	0.698	816	0.170	2540	0.528
June	4.32	4.51	2.20	+0.26	+0.003	9.89	9.91	9.90	9.728	+0.172	+0.175	+ 841	1791	0.373	2632	0.548	893	0.186	1739	0.362
July	4.58	4.64	3.09	+0.14	+0.002	9.83	9.97	9.90	9.900	−0.008	−0.006	− 29	1888	0.393	1859	0.387	918	0.191	941	0.196
Aug.	4.72	4.81	2.34	−0.08	−0.001	9.76	580.01	9.885	9.892	−0.077	−0.078	− 375	1898	0.395	1523	0.317	921	0.192	602	0.125
Sept.	4.64	4.46	1.96	−0.25	−0.003	9.66	579.83	9.745	9.815	−0.133	−0.136	− 654	1837	0.382	1183	0.246	897	0.187	286	0.059
Oct.	4.39	4.32	1.71	−0.31	−0.003	9.61	9.63	9.62	9.682	−0.152	−0.155	− 745	1842	0.383	1097	0.228	816	0.170	281	0.058
Nov.	4.08	3.85	2.21	−0.27	−0.003	9.39	9.49	9.44	9.530	−0.130	−0.133	− 639	1840	0.383	1201	0.250	822	0.171	379	0.079
Dec.	3.81	3.77	1.36	+0.21	+0.002	9.34	9.38	9.36	9.400	−0.025	−0.023	− 111	1683	0.350	1572	0.327	810	0.169	762	0.159
1897																				
Jan.	4.02	4.28	1.31	+0.44	+0.005	9.33	9.45	9.39	9.375	+0.013	+0.018	+ 86	1925	0.400	2011	0.418	767	0.160	1244	0.259
Feb.	4.46	4.64	1.51	+0.14	+0.002	9.41	9.36	9.385	9.388	+0.102	+0.104	+ 500	*a*1784	0.371	2284	0.475	709	0.147	1575	0.328
Mar.	4.60	4.57	1.90	+0.06	+0.001	9.72	9.47	9.595	9.490	+0.240	+0.241	+1158	1907	0.397	3065	0.638	712	0.148	2353	0.489
April	4.66	4.75	2.40	+0.32	+0.004	9.89	9.84	9.865	9.730	+0.400	+0.404	+1942	1849	0.385	3791	0.789	737	0.163	3054	0.635
May	4.98	5.20	2.82	+0.18	+0.002	580.38	580.41	580.395	580.130	+0.392	+0.394	+1894	1950	0.406	3844	0.800	803	0.167	3041	0.633
June	5.16	5.11	2.91	0.00	0.000	0.65	0.65	0.65	0.522	+0.220	+0.220	+1058	1871	0.389	2929	0.609	871	0.181	2058	0.428
July	5.16	5.22	2.91	+0.02	0.000	0.84	0.83	0.835	0.742	+0.080	+0.080	+ 385	1931	0.402	2316	0.482	912	0.190	1404	0.292
Aug.	5.18	5.15	2.79	−0.14	−0.002	0.78	0.81	0.822	0.822	−0.140	−0.142	− 683	1932	0.402	1249	0.260	942	0.196	307	0.064
Sept.	5.04	4.93	2.45	−0.28	−0.003	0.53	0.58	0.555	0.682	−0.287	−0.290	−1394	1926	0.401	532	0.111	910	0.198	− 378	−0.079
Oct.	4.76	4.58	1.95	−0.24	−0.003	0.24	0.23	0.235	0.395	−0.265	−0.268	−1288	1898	0.395	610	0.127	871	0.181	− 261	−0.054
Nov.	4.52	4.47	1.69	−0.14	−0.002	579.98	0.07	0.025	0.130	−0.225	−0.227	−1091	1916	0.399	825	0.172	850	0.177	− 25	−0.005
Dec.	4.38	4.29	1.78	−0.14	−0.002	9.76	579.81	579.785	579.905	−0.167	−0.169	− 812	1807	0.376	995	0.207	758	0.158	237	0.049

a.—Lake St. Clair discharge used.

TABLE 25.—Continued. SUPPLY FACTORS OF LAKE MICHIGAN-HURON.

DATE	WATER LEVELS OF DETROIT RIVER. Windmill Point. First of Month.	Windmill Point. Mean of Month.	Amherstburg, Ont., Mean of Month.	STORAGE IN LAKE ST. CLAIR. Foot Depth.	STORAGE IN LAKE ST. CLAIR. Equivalent Foot Depth, Lake Michigan-Huron.	WATER LEVELS OF LAKE MICHIGAN-HURON. Milwaukee Wis., Mean of Month.	Harbor Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbor Beach Mean of Month.	Mean, Milwaukee and Harbor Beach First of Month.	STORAGE IN LAKE MICHIGAN-HURON, Foot Depth.	STORAGE IN LAKE MICHIGAN-HURON AND LAKE ST. CLAIR. Foot Depth Lake Michigan-Huron.	100 c. f. s.	OUTFLOW THROUGH DETROIT RIVER. 100 c. f. s.	OUTFLOW THROUGH DETROIT RIVER. Ft. Depth Lake Michigan-Huron.	OUTFLOW THROUGH CHICAGO DRAINAGE CANAL. 100 c.f.s.	OUTFLOW THROUGH CHICAGO DRAINAGE CANAL. Ft Depth Lake Michigan-Huron.	TOTAL SUPPLY TO LAKE MICHIGAN-HURON. 100 c. f. s.	TOTAL SUPPLY TO LAKE MICHIGAN-HURON. Foot Depth.	INFLOW FROM ST. MARYS RIVER. 100 c. f. s.	INFLOW FROM ST. MARYS RIVER. Ft. Depth Lake Michigan-Huron.	LOCAL SUPPLY TO LAKE MICHIGAN-HURON. 100 c. f. s.	LOCAL SUPPLY TO LAKE MICHIGAN-HURON. Foot Depth
1898																							
Jan.	574.24	574.20	571.81	−0.26	−0.003	579.72	579.66	579.69	579.738	+0.002	−0.001	− 5	1756	0.365			1751	0.364	670	0.139	1081	0.225
Feb.	3.98	3.77	2.01	+0.28	+0.003	9.86	9.72	9.79	9.740	+0.188	+0.191	+ 918	1482	0.308			2400	0.499	627	0.130	1773	0.369
Mar.	4.26	4.76	2.29	+0.62	+0.007	580.18	9.95	580.065	9.928	+0.340	+0.347	+1668	1888	0.393			3556	0.740	599	0.125	2957	0.615
April	4.88	5.01	2.82	+0.18	+0.002	0.50	580.44	0.47	580.268	+0.302	+0.304	+1461	1848	0.384			3309	0.688	623	0.130	2628	0.559
May	5.06	5.11	3.06	+0.12	+0.001	0.78	0.56	0.67	0.570	+0.172	+0.173	+ 832	1818	0.378			2650	0.551	678	0.141	1972	0.410
June	5.18	5.26	3.08	+0.10	+0.001	0.91	0.72	0.815	0.742	+0.093	+0.094	+ 452	1893	0.394			2345	0.488	755	0.157	1590	0.331
July	5.28	5.30	2.87	−0.08	−0.001	0.89	0.82	0.855	0.835	−0.057	−0.058	− 279	1986	0.413			1707	0.355	819	0.170	888	0.185
Aug.	5.20	5.10	2.71	−0.20	−0.002	0.69	0.71	0.70	0.778	−0.213	−0.215	−1034	1931	0.402			897	0.187	841	0.175	56	0.012
Sept.	5.00	4.90	2.27	−0.23	−0.003	0.34	0.52	0.43	0.565	−0.215	−0.218	−1048	1964	0.409			916	0.191	866	0.180	50	0.010
Oct.	4.77	4.64	2.06	−0.13	−0.001	0.33	0.21	0.27	0.350	−0.202	−0.203	− 976	1896	0.394			920	0.191	836	0.174	84	0.017
Nov.	4.64	4.65	1.81	+0.02	0.000	579.92	0.13	0.025	0.148	−0.256	−0.256	−1231	1969	0.410			738	0.154	804	0.167	− 66	−0.014
Dec.	4.66	4.68	1.76	0.00	0.000	9.58	579.94	579.76	579.892	−0.210	−0.210	− 1009	1996	0.415			987	0.205	789	0.164	198	0.041
1899																						
Jan.	4.66	4.65	1.89	−0.05	−0.001	9.53	9.68	9.605	9.682	−0.092	−0.093	− 447	1947	0.405			1500	0.312	699	0.145	801	0.167
Feb.	4.61	4.57	1.68	−0.53	−0.006	9.61	9.54	9.575	9.590	+0.072	+0.066	+ 317	1856	0.386			2173	0.452	668	0.139	1505	0.313
Mar.	4.08	3.59	2.07	−0.12	−0.001	9.81	9.69	9.75	9.662	+0.198	+0.197	+ 947	1366	0.284			2313	0.481	648	0.135	1665	0.346
April	3.96	4.32	2.32	+0.64	+0.007	580.08	9.86	9.97	9.860	+0.355	+0.362	+1740	1655	0.344			3395	0.706	657	0.137	2738	0.570
May	4.60	4.88	2.72	+0.43	+0.005	0.52	580.46	580.46	580.215	+0.420	+0.425	+2043	1812	0.377			3855	0.802	819	0.170	3036	0.632
June	5.03	5.18	2.83	+0.21	+0.002	0.83	0.79	0.81	0.635	+0.300	+0.302	+1452	1935	0.403			3387	0.705	902	0.188	2485	0.517
July	5.24	5.30	2.76	+0.02	0.000	1.04	1.08	1.06	0.935	+0.083	+0.083	+ 399	2022	0.421			2421	0.504	940	0.196	1481	0.308
Aug.	5.26	5.22	2.59	−0.18	−0.002	0.96	0.99	0.975	1.018	−0.128	−0.130	− 625	2031	0.423			1406	0.292	968	0.201	438	0.091
Sept.	5.08	4.93	2.14	+0.71	+0.008	0.82	0.79	0.805	0.890	−0.270	−0.262	−1259	2015	0.419			756	0.157	1004	0.209	− 248	−0.052
Oct.	5.79	4.65	1.98	−1.22	−0.014	0.49	0.38	0.435	0.620	−0.265	−0.279	−1341	1923	0.400			582	0.121	942	0.196	− 360	−0.075
Nov.	4.57	4.49	1.85	−0.27	−0.003	0.31	0.24	0.275	0.355	−0.253	−0.256	−1231	1883	0.392			652	0.136	926	0.193	− 274	−0.057
Dec.	4.30	4.10	1.40	−0.24	−0.003	579.81	0.05	579.93	0.102	−0.267	−0.270	−1298	1822	0.379			524	0.109	917	0.191	− 393	−0.082
1900																						
Jan.	4.06	4.03	1.60	+0.08	+0.001	9.66	579.82	9.74	579.835	−0.065	−0.064	− 308	1736	0.361	15	0.003	1443	0.300	793	0.165	650	0.135
Feb.	4.14	4.24	1.80	+0.32	+0.004	9.77	9.83	9.80	9.770	+0.080	+0.084	+ 404	1778	0.370	23	0.005	2205	0.459	770	0.160	1435	0.299
Mar.	4.46	4.67	2.19	+0.20	+0.002	9.94	9.86	9.90	9.850	+0.112	+0.114	+ 548	1874	0.390	21	0.004	2443	0.508	723	0.150	1720	0.358
April	4.66	4.64	2.44	+0.06	+0.001	580.07	9.98	580.025	9.962	+0.160	+0.161	+ 774	1780	0.370	27	0.006	2581	0.537	730	0.152	1851	0.385
May	4.72	4.79	2.63	+0.17	+0.002	0.31	580.13	0.22	580.122	+0.168	+0.170	+ 817	1796	0.374	32	0.007	2645	0.550	764	0.159	1881	0.391
June	4.89	4.99	2.73	+0.11	+0.001	0.42	0.30	0.36	0.290	+0.160	+0.161	+ 774	1868	0.389	32	0.007	2674	0.556	777	0.162	1897	0.395
July	5.00	5.01	2.56	+0.04	0.000	0.53	0.55	0.54	0.450	+0.155	+0.155	+ 745	1932	0.402	34	0.007	2711	0.564	818	0.170	1893	0.394
Aug.	5.04	5.06	2.56	−0.06	−0.001	0.70	0.64	0.67	0.605	+0.073	+0.072	+ 346	1957	0.407	36	0.007	2339	0.487	857	0.178	1482	0.308
Sept.	4.98	4.89	2.20	−0.16	−0.002	0.65	0.72	0.685	0.678	−0.006	−0.008	− 38	1978	0.411	23	0.005	1963	0.408	948	0.197	1015	0.211
Oct.	4.82	4.74	2.03	−0.19	−0.002	0.66	0.66	0.66	0.672	−0.047	−0.049	− 236	1953	0.406	31	0.007	1751	0.364	954	0.198	787	0.166
Nov.	4.63	4.52	1.55	−0.17	−0.002	0.52	0.66	0.59	0.625	−0.167	−0.169	− 812	1974	0.411	38	0.008	1200	0.260	974	0.203	226	0.047
Dec.	4.46	4.41	1.60	−0.25	−0.003	0.19	0.46	0.325	0.458	−0.253	−0.256	−1231	1911	0.398	42	0.009	722	0.150	900	0.187	− 178	−0.037

1901																						
Jan.	4.21	4.01	1.63	−0.67	−0.007	579.95	0.22	0.085	0.205	−0.163	−0 170	− 817	1719	0.358	49	0.010	951	0.198	818	0.170	133	0.028
Feb.	3.54	3.06	1.19	−0.35	−0.004	9.92	0.08	0.00	0.042	+0.060	+0.056	+ 269	1410	0.293	51	0.011	1730	0.360	764	0.159	966	0.201
Mar.	3.19	3.32	1.12	−0.19	−0.002	580.34	0.07	0.205	0.102	+0.260	+0.258	+1240	1548	0.322	53	0.011	2841	0.591	725	0.151	2116	0.440
April	3.00	2.69	1.39	+0.32	+0.004	0.49	0.55	0.52	0.362	+0.330	+0.334	+1606	1161	0.241	44	0.009	2811	0.585	745	0.155	2066	0.430
May	3.32	3.94	1.56	+1.06	+0.012	0.92	0.81	0.865	0.692	+0.210	+0.222	+1067	1706	0.355	31	0.006	2804	0.583	798	0.166	2006	0.417
June	4.38	4.81	2.03	+0.54	+0.006	0.97	0.91	0.94	0.902	+0.098	+0.104	+ 500	1986	0.413	29	0.006	2515	0.523	814	0.169	1701	0.354
July	4.92	5.04	2.20	+0.14	+0.002	1.06	1.06	1.06	1.000	+0.085	+0.087	+ 418	2052	0.427	31	0.006	2501	0.520	888	0.185	1613	0.336
Aug.	5.06	5.07	2.14	−0.08	−0.001	1.11	1.11	1.11	1.085	−0.080	−0.081	− 389	2084	0.434	39	0.008	1734	0.361	920	0.191	814	0.169
Sept.	4.98	4.89	2.03	−0.26	−0.003	0.92	0.88	0.90	1.005	−0.250	−0.253	−1216	2025	0.421	39	0.008	848	0.176	896	0.186	− 47	−0.010
Oct.	4.72	4.56	1.59	−0.29	−0.003	0.56	0.66	0.61	0.755	−0.285	−0.288	−1384	1983	0.413	38	0.008	637	0.133	798	0.166	− 161	−0.033
Nov.	4.43	4.30	1.19	−0.05	−0.001	0.23	0.43	0.33	0.470	−0.292	−0.293	−1408	1963	0.408	39	0.008	594	0.124	788	0.164	− 194	−0.040
Dec.	4.38	4.47	1.62	−0.49	−0.005	579.95	0.10	0.025	0.178	−0 226	−0.231	−1110	1935	0.403	41	0.009	866	0.180	728	0.151	138	0.029
1902																						
Jan.	3.89	3.31	1.20	−0.75	−0.008	9.76	580.00	579.88	579.952	−0.157	−0.165	− 793	1522	0 317	42	0.009	771	0.160	670	0.139	101	0.021
Feb.	3.14	2.96	0.86	+0.32	+0.004	9.61	579.81	9.71	9.795	−0.047	−0.043	− 207	1464	0.305	42	0.009	1299	0.271	625	0.130	674	0.140
Mar.	3.46	3.96	1.13	+0 63	+0.007	9.84	9.73	9.785	9.748	+0.100	+0.107	+ 514	1827	0.380	42	0.009	2383	0 496	613	0.128	1770	0.368
April	4.09	4.22	1.63	+0.27	+0.003	9.91	9.91	9.91	9.848	+0.222	+0.225	+1082	1816	0.378	42	0.009	2940	0.612	638	0.133	2302	0.479
May	4 36	4.50	2.09	+0.33	+0 004	580.30	580.16	580.23	580.070	+0 290	+0.294	+1413	1818	0.378	42	0.009	3273	0.681	667	0.139	2606	0.542
June	4 69	4.88	2.33	+0.50	+0.006	0.50	0.48	0.49	0.360	+0.282	+0.288	+1384	1936	0.403	41	0.009	3361	0.699	725	0.151	2636	0.548
July	5 19	5.50	2.99	+0.27	+0.003	0.83	0.76	0.795	0.642	+0.176	+0.179	+ 860	2054	0.427	43	0.009	2957	0.615	760	0.158	2197	0.457
Aug.	5 46	5.41	3.00	−0.22	−0.002	0.85	0.83	0.84	0.818	−0 150	−0.152	− 731	2003	0 417	42	0.009	1314	0 273	762	0.159	552	0.115
Sept.	5.24	5.08	2.64	−0.24	−0.003	0.48	0.51	0.495	0.668	−0.270	−0.273	−1312	1944	0.404	43	0.009	675	0.140	770	0.160	− 95	−0.020
Oct.	5.00	4.92	2.50	−0.23	−0.003	0.33	0.27	0.30	0.398	−0.156	−0.159	− 764	1905	0.396	42	0.009	1183	0.246	746	0.155	437	0.091
Nov.	4.77	4.62	2.20	−0.14	−0.002	0.20	0.17	0.185	0.242	−0.190	−0.192	− 923	1846	0.384	42	0.009	965	0.201	757	0.157	208	0.043
Dec.	4.63	4.64	1.98	+0.03	0.000	579.91	579.93	579.92	0.052	−0.234	−0.234	−1125	1919	0.399	54	0.011	848	0.176	731	0.152	117	0.024
1903																						
Jan.	4.66	4.69	1 81	−0.12	−0.001	9.69	9.74	9.715	579.818	−0.053	−0.054	− 260	1988	0.414	61	0.013	1789	0.368	660	0.137	1129	0.235
Feb.	4.54	4.40	1.81	+0.04	0.000	9.85	9.78	9.815	9.765	+0.137	+0.137	+ 659	1851	0.385	57	0.012	2567	0.534	624	0.130	1943	0.404
Mar.	4.58	4 75	2.44	+0.45	+0.005	580.06	9.92	9.99	9.902	+0.243	+0.248	+1192	1837	0.382	53	0.011	3082	0.641	610	0.127	2472	0.514
April	5.03	5.31	3.20	+0.26	+0.003	0.33	580.27	580.30	580.145	+0.210	+0.213	+1024	1879	0.391	46	0.010	2949	0.613	649	0.135	2300	0.478
May	5.29	5.27	3.34	+0.03	0.000	0.43	0.39	0.41	0.355	+0.143	+0.143	+ 687	1803	0.375	46	0.010	2536	0.528	709	0.147	1827	0.380
June	5.32	5.38	3.22	+0.09	+0.001	0.61	0.56	0.585	0.498	+0.180	+0.181	+ 870	1911	0.398	48	0.010	2829	0.589	774	0.161	2055	0.428
July	5.41	5.44	3.18	−0.01	0.000	0.79	0.75	0.77	0.678	+0 070	+0.070	+ 336	1958	0.407	49	0.010	2343	0.487	795	0.165	1548	0.322
Aug.	5.40	5.36	2.99	−0.08	−0.001	0.72	0.73	0.725	0.748	+0.007	+0.006	+ 29	1978	0.411	45	0.009	2052	0.427	810	0 169	1242	0.258
Sept.	5.32	5.29	2.82	−0.16	−0.002	0.77	0.80	0.785	0.755	−0.030	−0.032	− 154	1997	0.415	43	0.009	1886	0.392	813	0.169	1073	0.223
Oct.	5.16	5.04	2.39	−0.37	−0.004	0.50	0.83	0.665	0.725	−0.255	−0.259	−1245	1999	0.416	45	0.009	799	0.166	838	0.174	− 39	−0.008
Nov.	4.79	4.54	1.84	−0.05	−0.001	0.14	0.41	0.275	0.470	−0.332	−0.333	−1601	1910	0.397	47	0.010	356	0.074	818	0.170	− 462	−0.096
Dec.	4.74	4.94	1.67	−0.40	−0.004	579.88	0.12	0.00	0.138	−0.186	−0.190	− 913	2138	0.445	56	0.012	1281	0 266	750	0.156	531	0.110
1904																						
Jan.	4.34	3.74	1.56	−0.51	−0.006	9.90	579.91	579.905	579.952	−0.057	−0.063	− 303	1612	0.335	55	0.011	1364	0.284	666	0.139	698	0.145
Feb.	3.83	3.92	1.61	+0.59	+0.007	9.86	9.91	9.885	9.895	+0.103	+0.096	+ 461	1682	0.350	52	0.011	2195	0.457	630	0.131	1565	0.326
Mar.	4.42	4.92	2.20	+0.86	+0.010	580.14	580.08	580.11	9.998	+0.364	+0.374	+1798	a1825	0.380	55	0 011	3678	0.765	593	0.123	3085	0.642
April	5.28	5.64	3.28	+0 34	+0.004	0.60	0 63	0.615	580.362	+0.423	+0.427	+2053	2035	0 423	49	0 010	4137	0.861	649	0.135	3488	0.726
May	5.62	5.61	3.60	+0 14	+0.002	0.95	0 96	0.955	0.785	+0 385	+0.387	+1860	1902	0.396	51	0.011	3813	0.793	700	0.146	3113	0.648
June	5.76	5.92	3.74	+0.18	+0.002	1.35	1.42	1.385	1.170	+0 250	+0.252	+1211	2031	0.423	41	0.009	3283	0.683	739	0 154	2544	0.529
July	5 94	5.97	3 68	−0 04	0 000	1.36	1 55	1 455	1.420	+0 005	+0.005	+ 24	2083	0 433	45	0 009	2152	0.448	760	0.158	1392	0 290
Aug.	5 90	5.82	3.38	−0 19	−0 002	1 26	1.53	1.395	1 425	−0.090	−0.092	− 442	2103	0.437	42	0.009	1703	0.354	771	0.160	932	0.194
Sept.	5.71	5.60	3.08	−0 25	−0.003	1.19	1.36	1.275	1.335	−0.117	−0.120	− 577	2079	0.432	42	0.009	1544	0 321	787	0.164	757	0 157
Oct.	5 46	5.31	2.73	−0.34	−0 004	1 06	1 26	1.16	1.218	−0.213	−0.217	−1043	2035	0.423	42	0.009	1034	0 215	813	0.169	221	0 046
Nov.	5.12	4.94	2.24	−0.20	−0.002	0.75	0.95	0.85	1.005	−0.345	−0.347	−1668	1992	0.414	42	0.009	366	0.076	796	0.166	− 430	−0.089
Dec.	4.92	4.89	2.05	−0 58	−0.006	0.44	0.50	0.47	0.660	−0.262	−0.268	−1288	2019	0.420	42	0.009	773	0.161	732	0.152	41	0.009

a.—St. Clair River discharge used.

TABLE 25.—Continued. SUPPLY FACTORS OF LAKE MICHIGAN-HURON.

DATE	WATER LEVELS OF DETROIT RIVER.			STORAGE IN LAKE ST. CLAIR.		WATER LEVELS OF LAKE MICHIGAN-HURON.				STORAGE IN LAKE MICHIGAN-HURON,	STORAGE IN LAKE MICHIGAN-HURON AND LAKE ST. CLAIR.		OUTFLOW THROUGH DETROIT RIVER.		OUTFLOW THROUGH CHICAGO DRAINAGE CANAL.		TOTAL SUPPLY TO LAKE MICHIGAN-HURON.		INFLOW FROM ST. MARYS RIVER.		LOCAL SUPPLY TO LAKE MICHIGAN-HURON.	
	Windmill Point.		Amherstburg, Ont., Mean of Month.	Foot Depth.	Equivalent Foot Depth, Lake Michigan-Huron.	Milwaukee Wis., Mean of Month.	Harbor Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbor Beach		Foot Depth.	Foot Depth, Lake Michigan-Huron.	100 c. f. s.	100 c. f. s.	Ft. Depth Lake Michigan-Huron.	100 c. f. s.	Ft. Depth Lake Michigan-Huron.	100 c. f. s.	Foot Depth.	100 c. f. s.	Ft. Depth Lake Michigan-Huron.	100 c. f. s.	Foot Depth
	First of Month.	Mean of Month.						Mean of Month.	First of Month.													
1905																						
Jan.	574.34	573.78	571.73	−0.70	−0.008	580.27	580.38	580.325	580.398	−0.108	−0.116	− 558	1580	0.329	42	0.009	1064	0.221	788	0.164	276	0.057
Feb.	3.64	3.50	1.45	+0.04	0.000	0.21	0.30	0.255	0.290	−0.008	−0.008	− 38	1534	0.319	42	0.009	1538	0.320	712	0.148	826	0.172
Mar.	3.68	3.87	1.55	+0.62	+0.007	0.33	0.29	0.31	0.282	+0.216	+0.223	+1072	1676	0.349	42	0.009	2790	0.580	670	0.139	2120	0.441
April	4.30	4.73	2.03	+0.62	+0.007	0.71	0.66	0.685	0.498	+0.324	+0.331	+1591	1947	0.405	42	0.009	3580	0.745	747	0.155	2833	0.589
May	4.92	5.11	2.76	+0.46	+0.005	0.97	0.95	0.96	0.822	+0.348	+0.353	+1697	1922	0.400	42	0.009	3661	0.762	801	0.166	2860	0.595
June	5.38	5.66	3.22	+0.35	+0.004	1.36	1.40	1.38	1.170	+0.298	+0.302	+1452	2066	0.430	42	0.009	3560	0.741	834	0.173	2726	0.567
July	5.73	5.80	3.30	+0.04	0.000	1.54	1.57	1.555	1.468	+0.077	+0.077	+ 370	2118	0.441	42	0.009	2530	0.526	899	0.187	1631	0.339
Aug.	5.77	5.74	3.18	−0.14	−0.002	1.51	1.56	1.535	1.545	−0.063	−0.065	− 312	2124	0.442	42	0.009	1854	0.386	923	0.192	931	0.194
Sept.	5.63	5.52	2.90	−0.28	−0.003	1.41	1.45	1.43	1.482	−0.220	−0.223	−1072	2094	0.436	42	0.009	1064	0.221	958	0.199	106	0.221
Oct.	5.35	5.18	2.45	−0.34	−0.004	0.97	1.22	1.095	1.262	−0.304	−0.308	−1481	2052	0.427	42	0.009	613	0.128	965	0.201	− 352	−0.073
Nov.	5.01	4.84	2.02	−0.23	−0.003	0.71	0.93	0.82	0.958	−0.243	−0.246	−1182	2004	0.417	42	0.009	864	0.180	923	0.192	− 59	−0.012
Dec.	4.78	4.73	2.05	+0.02	0.000	0.55	0.67	0.61	0.715	−0.145	−0.145	− 697	1942	0.404	42	0.009	1287	0.268	884	0.184	403	0.084
1906																						
Jan.	4.80	4.86	2.10	−0.38	−0.004	0.53	0.53	0.53	0.570	+0.038	+0.034	+ 163	1991	0.414	42	0.009	2196	0.457	821	0.171	1375	0.286
Feb.	4.42	3.99	2.14	−0.42	−0.005	0.68	0.69	0.685	0.608	+0.132	+0.127	+ 610	1548	0.322	42	0.009	2200	0.458	760	0.158	1440	0.300
Mar.	4.00	4.00	2.00	+0.44	+0.005	0.83	0.76	0.795	0.740	+0.145	+0.150	+ 721	1600	0.333	42	0.009	2363	0.492	720	0.150	1643	0.342
April	4.44	4.88	2.43	+0.60	+0.007	1.01	0.94	0.975	0.885	+0.220	+0.227	+1091	1905	0.396	42	0.009	3038	0.632	733	0.152	2305	0.480
May	5.04	5.20	2.68	+0.27	+0.003	1.27	1.20	1.235	1.105	+0.193	+0.196	+ 942	1993	0.415	42	0.009	2977	0.619	792	0.165	2185	0.455
June	5.31	5.42	2.92	+0.19	+0.002	1.39	1.33	1.36	1.298	+0.104	+0.106	+ 510	2034	0.423	42	0.009	2586	0.538	843	0.175	1743	0.363
July	5.50	5.58	3.02	+0.06	+0.001	1.44	1.45	1.445	1.402	+0.013	+0.014	+ 67	2089	0.435	42	0.009	2198	0.457	880	0.183	1318	0.274
Aug.	5.56	5.54	2.97	−0.14	−0.002	1.41	1.36	1.385	1.415	−0.177	−0.179	− 860	2082	0.433	42	0.009	1264	0.263	873	0.182	391	0.042
Sept.	5.42	5.30	2.70	−0.23	−0.003	1.06	1.12	1.09	1.238	−0.260	−0.263	−1264	2039	0.424	42	0.009	817	0.170	873	0.182	− 56	−0.012
Oct.	5.19	5.08	2.38	−0.15	−0.002	0.86	0.87	0.865	0.978	−0.206	−0.208	−1000	2021	0.420	42	0.009	1063	0.221	855	0.178	208	0.043
Nov.	5.04	4.99	2.32	−0.10	−0.001	0.68	0.68	0.68	0.772	−0.097	−0.098	− 471	1994	0.415	42	0.009	1565	0.326	823	0.171	742	0.154
Dec.	4.94	4.89	2.48	−0.02	0.000	0.69	0.65	0.67	0.675	−0.027	−0.027	− 130	1895	0.394	42	0.009	1807	0.376	779	0.162	1028	0.214
1907																						
Jan.	4.92	4.94	2.91	−0.12	−0.001	0.60	0.65	0.625	0.648	−0.006	−0.007	− 34	1779	0.370	42	0.009	1787	0.372	718	0.149	1069	0.222
Feb.	4.80	4.65	2.66	−0.18	−0.002	0.64	0.68	0.66	0.642	+0.033	+0.031	+ 149	1711	0.356	42	0.009	1902	0.396	683	0.142	1219	0.254
Mar.	4.62	4.60	2.47	+0.30	+0.003	0.70	0.68	0.69	0.675	+0.135	+0.138	+ 663	1749	0.364	42	0.009	2454	0.511	666	0.139	1788	0.372
April	4.92	5.24	2.94	+0.42	+0.005	0.96	0.90	0.93	0.810	+0.205	+0.210	+1010	1931	0.402	42	0.009	2983	0.621	712	0.148	2271	0.472
May	5.34	5.44	3.17	+0.27	+0.003	1.12	1.08	1.10	1.015	+0.253	+0.256	+1231	1962	0.408	42	0.009	3235	0.673	734	0.153	2501	0.520
June	5.61	5.78	3.63	+0.23	+0.003	1.48	1.39	1.435	1.268	+0.230	+0.233	+1120	1990	0.414	42	0.009	3152	0.656	810	0.169	2342	0.487
July	5.84	5.90	3.59	−0.01	0.000	1.48	1.64	1.56	1.498	0.000	0.000	0	2075	0.432	42	0.009	2117	0.440	849	0.177	1268	0.264
Aug.	5.83	5.76	3.35	−0.19	−0.002	1.38	1.49	1.435	1.498	−0.083	−0.085	− 409	2028	0.422	42	0.009	1661	0.346	880	0.183	781	0.162
Sept.	5.64	5.51	3.03	−0.18	−0.002	1.37	1.42	1.395	1.415	−0.125	−0.127	− 610	2047	0.426	42	0.009	1479	0.308	917	0.191	562	0.117
Oct.	5.46	5.40	2.94	−0.24	−0.003	1.16	1.21	1.185	1.290	−0.305	−0.308	−1481	2017	0.420	42	0.009	578	0.120	919	0.191	− 341	−0.071
Nov.	5.22	5.05	2.53	−0.22	−0.002	0.74	0.83	0.785	0.985	−0.280	−0.282	−1356	1961	0.408	42	0.009	647	0.135	891	0.185	− 244	−0.051
Dec.	5.00	4.96	2.41			0.63	0.62	0.625	0.705				1952	0.406	42	0.009			803	0.167		

TABLE 26.

SUPPLY FACTORS OF LAKE ERIE.

DATE	WATER LEVELS OF LAKE ERIE			STORAGE IN LAKE ERIE		OUTFLOW THROUGH NIAGARA RIVER. *a*		TOTAL SUPPLY TO LAKE ERIE		INFLOW FROM DETROIT RIVER		LOCAL SUPPLY TO LAKE ERIE.	
	CLEVELAND, O.		Buffalo, N.Y. Mean of Month.										
	First of Month	Mean of Month.		Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1860													
Jan.		573.26	573.51			2321	2.19			2125	2.01		
Feb.	573.08	2 90	2.93	+0.02	+ 21	2178	2.06	2199	2.08	1447	1.37	+752	+0.71
Mar.	3.10	3.30	3.28	+0.55	+582	2265	2.14	2847	2.69	1942	1.84	+905	+0.86
April	3.65	4.00	3.91	+0.45	+476	2423	2.29	2899	2.74	2051	1.94	+848	+0.80
May	4.10	4.21	4.11	+0.10	+106	2475	2.34	2581	2.44	2214	2.09	+367	+0.35
June	4.20	4.18	4.15	−0.15	−159	2486	2.35	2327	2.20	2326	2.20	+ 1	0.00
July	4.05	3.92	3.96	−0.21	−222	2436	2.30	2214	2.09	2002	1.89	+212	+0.20
Aug.	3.84	3.76	3.72	−0.25	−264	2375	2.25	2111	2.00	1995	1.89	+116	+0.11
Sept.	3.59	3.42	3.44	−0.32	−338	2304	2.18	1966	1.86	1894	1.79	+ 72	+0.07
Oct.	3.27	3.12	3.20	−0.19	−201	2244	2.12	2043	1.93	2376	2.25	−333	−0.31
Nov.	3.08	3.03	3.22	−0.13	−137	2248	2.13	2111	2.00	1935	1.83	+176	+0.17
Dec	2.95	2.87	3.25	−0.21	−222	2256	2.13	2034	1.92	2250	2.13	−216	−0.20
1861													
Jan.	2.74	2.61	2.86	−0.27	−286	2161	2.04	1875	1.77	*b*2306	2.18	−431	−0.41
Feb.	2.47	2.33	2.36	+0.08	+ 85	2045	1.93	2130	2.01	1723	1.63	+407	+0.39
Mar.	2.55	2.77	2.75	+0.74	+782	2136	2.02	2918	2.76	2166	2.05	+752	+0.71
April	3.29	3.81	3.72	+0.73	+772	2375	2.25	3147	2.98	2290	2.17	+857	+0.81
May	4.02	4.24	4.14	+0.26	+275	2485	2.35	2760	2.61	2164	2.05	+596	+0.56
June	4.28	4.31	4.28	−0.10	−106	2521	2.38	2415	2.28	2274	2.15	+141	+0.13
July	4.18	4.06	4.10	−0.10	−106	2474	2.34	2368	2.24	2324	2.20	+ 44	+0.04
Aug.	4.08	4.10	4.06	−0.07	− 74	2463	2.33	2389	2.26	2409	2.28	− 20	−0.02
Sept.	4.01	3.92	3.94	−0.21	−222	2431	2.30	2209	2.09	2358	2.23	−149	−0.14
Oct.	3.80	3.69	3.77	−0.12	−127	2387	2.26	2260	2.14	2299	2.17	− 39	−0.04
Nov.	3.68	3.67	3.86	−0.12	−127	2410	2.28	2283	2.16	2262	2.14	+ 21	+0.02
Dec.	3.56	3.44	3.82	−0.12	−127	2401	2.27	2274	2.15	2264	2.14	+ 10	+0.01
1862													
Jan.	3.44	3.43	3.68	−0.16	−169	2365	2.24	2196	2.08	2053	1.94	+143	+0.13
Feb.	3.28	3.14	3.17	−0.07	− 74	2237	2.12	2163	2.05	1521	1.44	+642	+0.61
Mar.	3.21	3.28	3.26	+0.52	+550	2258	2.14	2808	2.66	2024	1.91	+784	+0.74
April	3.73	4.18	4.09	+0.57	+603	2471	2.34	3074	2.91	2446	2.31	+628	+0.59
May	4.30	4.42	4.32	+0.12	+127	2531	2.39	2658	2.51	2358	2.23	+300	+0.28
June	4.42	4.42	4.39	−0.02	− 21	2551	2.41	2530	2.39	2393	2.26	+137	+0.13
July	4.40	4.39	4.43	−0.20	−211	2562	2.42	2351	2.22	2370	2.24	− 19	−0.02
Aug.	4.20	4.01	3.97	−0.34	−360	2439	2.31	2079	1.97	2428	2.30	−349	−0.33
Sept.	3.86	3.70	3.72	−0.35	−370	2375	2.25	2005	1.90	2411	2.28	−406	−0.38
Oct.	3.51	3.32	3.40	−0.36	−381	2294	2.17	1913	1.81	2398	2.27	−485	−0.46
Nov.	3.15	2.98	3.17	−0.15	−159	2237	2.12	2078	1.97	2362	2.23	−284	−0.27
Dec.	3.00	3.01	3.39	+0.24	+254	2291	2.17	2545	2.41	2212	2.09	+333	+0.31
1863													
Jan.	3.24	3.46	3.71	+0.36	+381	2372	2.24	2753	2.60	2153	2.04	+600	+0.57
Feb.	3.60	3.75	3.78	+0.12	+127	2390	2.26	2517	2.38	2040	1.93	+477	+0.45
Mar.	3.72	3.69	3.67	+0.03	+ 32	2361	2.23	2393	2.26	1878	1.78	+515	+0.49
April	3.75	3.81	3.72	+0.15	+159	2375	2.25	2534	2.40	2122	2.01	+412	+0.39
May	3.90	3.99	3.89	+0.02	+ 21	2418	2.29	2439	2.31	2307	2.18	+132	+0.12
June	3.92	3.85	3.82	−0.13	−137	2400	2.27	2263	2.14	2204	2.08	+ 59	+0.06
July	3.79	3.73	3.77	−0.10	−106	2387	2.26	2281	2.16	2340	2.21	− 59	−0.06
Aug.	3.69	3.65	3.61	−0.23	−243	2346	2.22	2103	1.99	2336	2.21	−233	−0.22
Sept.	3.46	3.26	3.28	−0.42	−444	2264	2.14	1820	1.72	2363	2.23	−543	−0.51
Oct.	3.04	2.82	2.90	−0.42	−444	2172	2.05	1728	1.63	2202	2.08	−474	−0.45
Nov.	2.62	2.41	2.60	−0.22	−233	2101	1.99	1868	1.77	2263	2.14	−395	−0.37
Dec.	2.40	2.38	2.76	−0.16	−169	2137	2.02	1968	1.86	2187	2.07	−219	−0.21
1864													
Jan.	2.24	2.09	2.34	−0.08	− 85	2041	1.93	1956	1.85	*b*2278	2.15	−322	−0.30
Feb.	2.16	2.24	2.27	+0.18	+190	2025	1.92	2215	2.09	2043	1.93	+172	+0.16
Mar.	2.34	2.45	2.43	+0.36	+381	2061	1.95	2442	2.31	2048	1.94	+394	+0.37
April	2.70	2.95	2.84	+0.60	+634	2157	2.04	2791	2.64	*b*2201	2.08	+590	+0.56
May	3.30	3.65	3.55	+0.32	+338	2332	2.21	2670	2.52	2309	2.18	+361	+0.34
June	3.62	3.60	3.57	−0.15	−159	2337	2.21	2178	2.06	2453	2.32	−275	−0.26
July	3.47	3.34	3.38	−0.27	−286	2288	2.16	2002	1.89	2376	2.25	−374	−0.35
Aug.	3.20	3.07	3.03	−0.24	−254	2203	2.08	1949	1.84	2341	2.21	−392	−0.37
Sept.	2.96	2.85	2.87	−0.26	−275	2165	2.05	1890	1.79	2310	2.18	−420	−0.40
Oct.	2.70	2.54	2.62	−0.24	−254	2105	1.99	1851	1.75	2121	2.01	−270	−0.26
Nov.	2.46	2.37	2.56	−0.06	− 63	2091	1.98	2028	1.92	2162	2.04	−134	−0.13
Dec.	2.40	2.44	2.82	−0.18	−190	2153	2.04	1963	1 86	2133	2.02	−170	−0.16

a.—Discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

DATE	WATER LEVELS OF LAKE ERIE			STORAGE IN LAKE ERIE		OUTFLOW THROUGH NIAGARA RIVER. *a*		TOTAL SUPPLY TO LAKE ERIE		INFLOW FROM DETROIT RIVER		LOCAL SUPPLY TO LAKE ERIE.	
	CLEVELAND, O.		Buffalo, N.Y. Mean of Month.										
	First of Month	Mean of Month.		Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1865													
Jan.	572.22	572.01	572.26	−0.50	−529	2022	1.91	1493	1.41	1594	1.51	−101	−0.10
Feb.	1.72	1.43	1.46	−0.13	−137	1846	1.75	1709	1.62	1446	1.37	+263	+0.25
Mar.	1.59	1.75	1.73	+0.52	+550	1904	1.80	2454	2.32	1693	1.60	+761	+0.72
April	2.11	2.47	2.38	+0.65	+687	2050	1.94	2737	2.59	2092	1.98	+645	+0.61
May	2.76	3.05	2.95	+0.28	+296	2183	2.06	2479	2.34	2204	2.08	+275	+0.26
June	3.04	3.03	3.00	−0.03	− 32	2195	2.08	2163	2.05	2241	2.12	− 78	−0.07
July	3.01	2.99	3.03	−0.06	− 63	2203	2.08	2140	2.02	2333	2.21	−193	−0.18
Aug.	2.95	2.91	2.87	−0.06	− 63	2165	2.05	2102	1.99	2340	2.21	−238	−0.23
Sept.	2.89	2.87	2.89	−0.17	−180	2171	2.05	1991	1.88	2321	2.19	−330	−0.31
Oct.	2.72	2.57	2.65	−0.34	−360	2112	2.00	1752	1.66	2276	2.15	−524	−0.50
Nov.	2.38	2.19	2.38	−0.26	−275	2050	1.94	1775	1.68	2179	2.06	−404	−0.38
Dec.	2.12	2.05	2.43	−0.20	−211	2061	1.95	1850	1.75	2087	1.97	−237	−0.22
1866													
Jan.	1.92	1.78	2.03	−0.22	−233	1971	1.86	1738	1.64	*b*2026	1.92	−288	−0.27
Feb.	1.70	1.62	1.65	+0.12	+127	1887	1.78	2014	1.90	1928	1.82	+ 86	+0.08
Mar.	1.82	2.01	1.99	+0.48	+508	1962	1.86	2470	2.34	1850	1.75	+620	+0.59
April	2.30	2.59	2.50	+0.40	+423	2077	1.96	2500	2.36	*b*1964	1.87	+536	+0.51
May	2.70	2.81	2.71	+0.24	+254	2125	2.01	2379	2.25	2098	1.98	+281	+0.27
June	2.94	3.07	3.04	+0.18	+190	2206	2.09	2396	2.27	2183	2.06	+213	+0.20
July	3.12	3.18	3.22	−0.06	− 63	2248	2.13	2185	2.07	2268	2.14	− 83	−0.08
Aug.	3.06	2.93	2.89	−0.16	−169	2169	2.05	2000	1.89	2256	2.13	−256	−0.24
Sept.	2.90	2.87	2.89	−0.04	− 42	2169	2.05	2127	2.01	2243	2.12	−116	−0.11
Oct.	2.86	2.86	2.94	−0.12	−127	2181	2.06	2054	1.94	2228	2.11	−174	−0.16
Nov.	2.74	2.62	2.81	−0.12	−127	2150	2.03	2023	1.91	2295	2.17	−272	−0.26
Dec.	2.62	2.63	3.01	−0.14	−148	2197	2.08	2049	1.94	2272	2.15	−223	−0.21
1867													
Jan.	2.48	2.34	2.59	−0.30	−317	2098	1.98	1781	1.68	1881	1.78	−100	−0.09
Feb.	2.18	2.02	2.05	+0.04	+ 42	1975	1.87	2017	1.91	1996	1.89	+ 21	+0.02
Mar.	2.22	2.42	2.40	+0.36	+381	2055	1.94	2436	2.30	1641	1.55	+795	+0.75
April	2.58	2.74	2.65	+0.42	+444	2112	2.00	2556	2.42	*b*2118	2.00	+438	+0.41
May	3.00	3.26	3.16	+0.42	+444	2234	2.11	2678	2.53	2299	2.17	+379	+0.36
June	3.42	3.57	3.54	+0.06	+ 63	2330	2.20	2393	2.26	2427	2.30	− 34	−0.03
July	3.48	3.38	3.42	−0.26	−275	2298	2.17	2023	1.91	2381	2.25	−358	−0.34
Aug.	3.22	3.07	3.03	−0.34	−360	2203	2.08	1843	1.74	2420	2.29	−577	−0.55
Sept.	2.88	2.68	2.70	−0.37	−391	2123	2.01	1732	1.64	2337	2.21	−605	−0.57
Oct.	2.51	2.34	2.42	−0.42	−444	2058	1.95	1614	1.53	2231	2.11	−617	−0.58
Nov.	2.09	1.84	2.03	−0.36	−381	1970	1.86	1589	1.50	2154	2.04	−565	−0.53
Dec.	1.73	1.62	2.00	−0.21	−222	1964	1.86	1742	1.65	2093	1.98	−351	−0.33
1868													
Jan.	1.52	1.42	1.67	−0.29	−307	1891	1.79	1584	1.50	*b*2042	1.93	−458	−0.43
Feb.	1.23	1.04	1.07	+0.11	+116	1765	1.67	1881	1.78	1733	1.64	+148	+0.14
Mar.	1.34	1.63	1.61	+0.70	+740	1878	1.78	2618	2.48	2179	2.06	+439	+0.42
April	2.04	2.46	2.37	+0.64	+677	2048	1.94	2725	2.58	2095	1.98	+630	+0.60
May	2.68	2.91	2.81	+0.42	+444	2149	2.03	2593	2.45	2209	2.09	+384	+0.36
June	3.10	3.30	3.27	+0.18	+190	2261	2.14	2451	2.32	2266	2.14	+185	+0.17
July	3.28	3.27	3.31	−0.27	−286	2270	2.15	1984	1.88	2211	2.09	−227	−0.21
Aug.	3.01	2.75	2.71	−0.39	−412	2125	2.01	1713	1.62	2180	2.06	−467	−0.44
Sept.	2.62	2.48	2.50	−0.36	−381	2077	1.96	1696	1.60	2146	2.03	−450	−0.43
Oct.	2.26	2.03	2.11	−0.31	−328	1987	1.88	1659	1.57	2064	1.95	−405	−0.38
Nov.	1.95	1.87	2.06	−0.19	−201	1976	1.87	1775	1.68	2016	1.91	−241	−0.23
Dec.	1.76	1.66	2.04	−0.10	−106	1973	1.87	1867	1.77	1998	1.89	−131	−0.12
1869													
Jan.	1.66	1.65	1.90	−0.04	− 42	1941	1.84	1899	1.80	1844	1.74	+ 55	+0.05
Feb	1.62	1.58	1.61	+0.20	+211	1878	1.78	2089	1.98	1692	1.60	+397	+0.38
Mar.	1.82	2.06	2.04	+0.39	+412	1973	1.87	2385	2.26	1607	1.52	+778	+0.74
April	2.21	2.36	2.27	+0.43	+455	2025	1.92	2480	2.35	1976	1.87	+504	+0.48
May	2.64	2.91	2.81	+0.46	+486	2149	2.03	2635	2.49	1848	1.75	+787	+0.74
June	3.10	3.30	3.27	+0.34	+360	2261	2.14	2621	2.48	2030	1.92	+591	+0.56
July	3.44	3.58	3.62	+0.09	+ 95	2348	2.22	2443	2.31	2184	2.07	+259	+0.24
Aug.	3.53	3.48	3.44	−0.19	−201	2304	2.18	2103	1.99	2211	2.09	−108	−0.10
Sept.	3.34	3.21	3.23	−0.36	−381	2251	2.13	1870	1.77	2192	2.07	−322	−0.30
Oct.	2.98	2.76	2.84	−0.45	−476	2157	2.04	1681	1.59	2091	1.98	−410	−0.39
Nov.	2.53	2.30	2.49	−0.05	− 53	2075	1.96	2022	1.91	2121	2.01	− 99	−0.09
Dec.	2.48	2.65	3.03	+0.29	+307	2203	2.08	2510	2.37	2133	2.02	+377	+0.36

a.—Discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

DATE	WATER LEVELS OF LAKE ERIE			STORAGE IN LAKE ERIE		OUTFLOW THROUGH NIAGARA RIVER. *a*		TOTAL SUPPLY TO LAKE ERIE		INFLOW FROM DETROIT RIVER		LOCAL SUPPLY TO LAKE ERIE.	
	CLEVELAND, O.		Buffalo, N.Y. Mean of Month.										
	First of Month	Mean of Month.		Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1870													
Jan.	572.77	572.89	573.14	+0.23	+ 243	2229	2.11	2472	2.34	*b*2021	1.91	+ 451	+0.43
Feb.	3.00	3.12	3.15	0.00	0	2231	2.11	2231	2.11	1757	1.66	+ 474	+0.45
Mar.	3.00	2.89	2.87	+0.22	+ 233	2164	2.05	2397	2.27	1853	1.75	+ 544	+0.51
April	3.22	3.54	3.45	+0.42	+ 444	2306	2.18	2750	2.60	2154	2.04	+ 596	+0.56
May	3.64	3.75	3.65	+0.10	+ 106	2356	2.23	2462	2.33	2212	2.09	+ 250	+0.24
June	3.74	3.72	3.69	0.00	0	2368	2.24	2368	2.24	2354	2.23	+ 14	+0.01
July	3.74	3.76	3.80	0.00	0	2395	2.26	2395	2.26	2456	2.32	− 61	−0.06
Aug.	3.74	3.71	3.67	−0.16	− 169	2361	2.23	2192	2.07	2431	2.30	− 239	−0.23
Sept.	3.58	3.46	3.48	−0.31	− 328	2314	2.19	1986	1.88	2373	2.24	− 387	−0.37
Oct.	3.27	3.08	3.16	−0.34	− 360	2234	2.11	1874	1.77	2248	2.13	− 374	−0.35
Nov.	2.93	2.78	2.97	−0.21	− 222	2188	2.07	1966	1.86	2248	2.13	− 282	−0.27
Dec.	2.72	2.66	3.04	−0.16	− 169	2206	2.09	2037	1.93	2210	2.09	− 173	−0.16
1871													
Jan.	2.56	2.45	2.70	−0.28	− 296	2123	2.01	1827	1.73	2059	1.95	− 232	−0.22
Feb.	2.28	2.12	2.15	+0.06	+ 63	1997	1.89	2060	1.95	1679	1.59	+ 381	+0.36
Mar.	2.34	2.57	2.55	+0.47	+ 497	2088	1.97	2585	2.44	*b*2257	2.13	+ 328	+0.31
April	2.81	3.05	2.96	+0.37	+ 391	2185	2.07	2576	2.44	2370	2.24	+ 206	+0.19
May	3.18	3.32	3.22	+0.16	+ 169	2248	2.13	2417	2.29	2429	2.30	− 12	−0.01
June	3.34	3.35	3.32	0.00	0	2273	2.15	2273	2.15	2463	2.33	− 190	−0.18
July	3.34	3.33	3.37	−0.12	− 127	2285	2.16	2158	2.04	2466	2.33	− 308	−0.29
Aug.	3.22	3.12	3.08	−0.18	− 190	2215	2.09	2025	1.92	2415	2.28	− 390	−0.37
Sept.	3.04	2.95	2.97	−0.42	− 444	2188	2.07	1744	1.65	2319	2.19	− 575	−0.54
Oct.	2.62	2.28	2.36	−0.43	− 455	2045	1.93	1590	1.50	2186	2.07	− 596	−0.56
Nov.	2.19	2.10	2.29	−0.31	− 328	2029	1.92	1701	1.61	2174	2.06	− 473	−0.45
Dec.	1.88	1.66	2.04	−0.26	− 275	1973	1.87	1698	1.61	2334	2.21	− 636	−0.60
1872													
Jan.	1.62	1.58	1.83	−0.16	− 169	1925	1.82	1756	1.66	1995	1.89	− 239	−0.23
Feb.	1.46	1.34	1.37	−0.16	− 169	−1828	1.73	1659	1.57	2032	1.92	− 373	−0.35
Mar.	1.30	1.25	1.23	+0.05	+ 53	1798	1.70	1851	1.75	1936	1.83	− 85	−0.08
April	1.35	1.45	1.36	+0.32	+ 338	1825	1.73	2163	2.05	*b*1996	1.89	+ 167	+0.16
May	1.67	1.89	1.79	+0.41	+ 434	1917	1.81	2351	2.22	2100	1.99	+ 251	+0.24
June	2.08	2.26	2.23	+0.18	+ 190	2016	1.91	2206	2.09	2217	2.10	− 11	−0.01
July	2.26	2.25	2.29	−0.02	− 21	2029	1.92	2008	1.90	2059	1.95	− 51	−0.05
Aug.	2.24	2.22	2.18	−0.14	− 148	2005	1.90	1857	1.76	2132	2.02	− 275	−0.26
Sept.	2.10	1.99	2.01	−0.20	− 211	1966	1.86	1755	1.66	2126	2.01	− 371	−0.35
Oct.	1.90	1.82	1.90	−0.24	− 254	1941	1.84	1687	1.60	2146	2.03	− 459	−0.43
Nov.	1.66	1.49	1.68	−0.28	− 296	1893	1.79	1597	1.51	2024	1.91	− 427	−0.40
Dec.	1.38	1.26	1.64	−0.17	− 180	−1885	1.78	1705	1.61	2005	1.90	− 300	−0.28
1873													
Jan.	1.21	1.16	1.41	−0.05	− 53	1835	1.74	1782	1.69	1796	1.70	− 14	−0.01
Feb.	1.16	1.17	1.20	+0.04	+ 42	1792	1.69	1834	1.73	1924	1.82	− 90	−0.09
Mar.	1.20	1.24	1.22	+0.68	+ 719	1796	1.70	2515	2.38	2069	1.96	+ 446	+0.42
April	1.88	2.52	2.43	+0.98	+1036	2061	1.95	3097	2.93	*b*1991	1.88	+1106	+1.05
May	2.86	3.19	3.09	+0.37	+ 391	2217	2.10	2608	2.47	1997	1.89	+ 611	+0.58
June	3.23	3.27	3.24	+0.03	+ 32	2255	2.13	2287	2.16	2133	2.02	+ 154	+0.15
July	3.26	3.25	3.29	−0.04	− 42	2267	2.14	2225	2.10	2195	2.08	+ 30	+0.03
Aug.	3.22	3.19	3.15	−0.23	− 243	2231	2.11	1988	1.88	2201	2.08	− 213	−0.20
Sept.	2.99	2.79	2.81	−0.35	− 370	2150	2.03	1780	1.68	2202	2.08	− 422	−0.40
Oct.	2.64	2.49	2.57	−0.25	− 264	2094	1.98	1830	1.73	2141	2.02	− 311	−0.29
Nov.	2.39	2.29	2.48	+0.09	+ 95	2072	1.96	2167	2.05	2134	2.02	+ 33	+0.03
Dec.	2.48	2.66	3.04	+0.38	+ 402	2206	2.09	2608	2.47	2067	1.95	+ 541	+0.51
1874													
Jan.	2.86	3.05	3.30	+0.22	+ 233	2269	2.15	2502	2.37	1470	1.39	+1032	+0.98
Feb.	3.08	3.10	3.13	+0.04	+ 42	2227	2.11	2269	2.15	1053	1.00	+1216	+1.15
Mar.	3.12	3.13	3.11	+0.10	+ 106	2221	2.10	2327	2.20	1947	1.84	+ 380	+0.36
April	3.22	3.30	3.21	+0.12	+ 127	2246	2.12	2373	2.24	2053	1.94	+ 320	+0.30
May	3.34	3.39	3.29	+0.08	+ 85	2267	2.14	2352	2.22	1998	1.89	+ 354	+0.33
June	3.42	3.46	3.43	+0.06	+ 63	2301	2.18	2364	2.24	2106	1.99	+ 258	+0.24
July	3.48	3.49	3.53	−0.07	− 74	2327	2.20	2253	2.13	2168	2.05	+ 85	+0.08
Aug.	3.41	3.33	3.29	−0.31	− 328	2267	2.14	1939	1.83	2164	2.05	− 225	−0.21
Sept.	3.10	2.87	2.89	−0.45	− 476	2170	2.05	1694	1.60	2200	2.08	− 506	−0.48
Oct.	2.65	2.43	2.51	−0.43	− 455	2079	1.97	1624	1.54	2185	2.07	− 561	−0.53
Nov.	2.22	2.01	2.20	−0.32	− 338	2009	1.90	1671	1.58	2183	2.06	− 512	−0.48
Dec.	1.90	1.80	2.18	−0.22	− 233	2005	1.90	1772	1.68	2027	1.92	− 255	−0.24

a.—Discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

DATE	WATER LEVELS OF LAKE ERIE			STORAGE IN LAKE ERIE		OUTFLOW THROUGH NIAGARA RIVER. *a*		TOTAL SUPPLY TO LAKE ERIE		INFLOW FROM DETROIT RIVER		LOCAL SUPPLY TO LAKE ERIE.	
	CLEVELAND, O.		Buffalo, N.Y.										
	First of Month	Mean of Month.	Mean of Month.	Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1875													
Jan.	571.68	571.57	571.82	−0.20	− 211	1923	1.82	1712	1.62	2008	1.90	− 296	−0.28
Feb.	1.48	1.40	1.43	−0.01	− 11	1840	1.74	1829	1.73	2045	1.93	− 216	−0.20
Mar.	1.47	1.54	1.52	+0.27	+ 286	1860	1.76	2146	2.03	2093	1.98	+ 53	+0.05
April	1.74	1.94	1.85	+0.44	+ 465	1929	1.82	2394	2.26	2027	1.92	+ 367	+0.35
May	2.18	2.41	2.31	+0.44	+ 465	2033	1.92	2498	2.36	2187	2.07	+ 311	+0.29
June	2.62	2.84	2.81	+0.28	+ 296	2149	2.03	2445	2.31	2157	2.04	+ 288	+0.27
July	2.90	2.97	3.01	+0.06	+ 63	2197	2.08	2260	2.14	2218	2.10	+ 42	+0.04
Aug.	2.96	2.96	2.92	−0.07	− 74	2176	2.06	2102	1.99	2175	2.06	− 73	−0.07
Sept.	2.89	2.82	2.84	−0.31	− 328	2157	2.04	1829	1.73	2140	2.02	− 311	−0.29
Oct.	2.58	2.33	2.41	−0.32	− 338	2056	1.94	1718	1.62	2177	2.06	− 459	−0.43
Nov.	2.26	2.18	2.37	+0.03	+ 32	2047	1.94	2079	1.97	2158	2.04	− 79	−0.07
Dec.	2.29	2.40	2.78	+0.09	+ 95	2143	2.03	2238	2.12	1980	1.87	+ 258	+0.24
1876													
Jan.	2.38	2.36	2.61	+0.26	+ 275	2102	1.99	2377	2.25	2060	1.95	+ 317	+0.30
Feb.	2.64	2.92	2.95	+0.60	+ 634	2183	2.06	2817	2.66	2160	2.04	+ 657	+0.62
Mar.	3.24	3.57	3.55	+0.59	+ 624	2332	2.21	2956	2.80	*b*2188	2.07	+ 768	+0.73
April	3.83	4.09	4.00	+0.42	+ 444	2446	2.31	2890	2.73	2240	2.12	+ 650	+0.61
May	4.25	4.41	4.31	+0.21	+ 222	2528	2.39	2750	2.60	1955	1.85	+ 795	+0.75
June	4.46	4.52	4.49	0.00	0	2578	2.44	2578	2.44	2511	2.37	+ 67	+0.06
July	4.46	4.41	4.45	−0.20	− 211	2567	2.43	2356	2.23	2627	2.48	− 271	−0.26
Aug.	4.26	4.11	4.07	−0.24	− 254	2465	2.33	2211	2.09	2618	2.48	− 407	−0.38
Sept.	4.02	3.94	3.96	−0.34	− 360	2435	2.30	2075	1.96	2389	2.26	− 314	−0.30
Oct.	3.68	3.41	3.49	−0.23	− 243	2317	2.19	2074	1.96	2352	2.22	− 278	−0.26
Nov	3.45	3.49	3.68	−0.13	− 137	2365	2.24	2228	2.11	2300	2.18	− 72	−0.07
Dec.	3.32	3.15	3.53	−0.37	− 391	2327	2.20	1936	1.83	*b*2283	2.16	− 347	−0.33
1877													
Jan.	2.95	2.75	3.00	−0.28	− 296	2196	2.08	1900	1.80	*b*2371	2.24	− 471	−0.45
Feb.	2.67	2.59	2.62	−0.19	− 201	2105	1.99	1904	1.80	1947	1.84	− 43	−0.04
Mar.	2.48	2.36	2.34	+0.10	+ 106	2041	1.93	2147	2.03	1342	1.27	+ 805	+0.76
April	2.58	2.79	2.70	+0.34	+ 360	2124	2.01	2484	2.35	1753	1.66	+ 731	+0.69
May	2.92	3.04	2.94	+0.16	+ 169	2181	2.06	2350	2.22	1799	1.70	+ 551	+0.52
June	3.08	3.12	3.09	+0.16	+ 169	2217	2.10	2386	2.26	2251	2.13	+ 135	+0.13
July	3.24	3.36	3.40	+0.05	+ 53	2294	2.17	2347	2.22	2290	2.17	+ 57	+0.05
Aug.	3.29	3.22	3.18	−0.11	− 116	2239	2.12	2123	2.01	2277	2.15	− 154	−0.15
Sept.	3.18	3.14	3.16	−0.24	− 254	2234	2.11	1980	1.87	2164	2.05	− 184	−0.17
Oct.	2.94	2.74	2.82	−0.24	− 254	2152	2.04	1898	1.79	2232	2.11	− 334	−0.32
Nov.	2.70	2.66	2.85	0.00	0	2159	2.04	2159	2.04	1943	1.84	+ 216	+0.20
Dec.	2.70	2.74	3.12	+0.08	+ 85	2225	2.10	2310	2.18	2149	2.03	+ 161	+0.15
1878													
Jan.	2.78	2.82	3.07	+0.11	+ 116	2213	2.09	2329	2.20	2054	1.94	+ 275	+0.26
Feb.	2.89	2.96	2.99	+0.13	+ 137	2195	2.08	2332	2.21	1518	1.44	+ 814	+0.77
Mar.	3.02	3.09	3.07	+0.28	+ 296	2213	2.09	2509	2.37	1566	1.48	+ 943	+0.89
April	3.30	3.51	3.42	+0.33	+ 349	2298	2.17	2647	2.50	2217	2.10	+ 430	+0.41
May	3.63	3.75	3.65	+0.12	+ 127	2356	2.23	2483	2.35	2231	2.11	+ 252	+0.24
June	3.75	3.75	3.72	0.00	0	2375	2.25	2375	2.25	2271	2.15	+ 104	+0.10
July	3.75	3.75	3.79	−0.11	− 116	2393	2.26	2277	2.15	2316	2.19	− 39	−0.04
Aug.	3.64	3.53	3.49	−0.18	− 190	2317	2.19	2127	2.01	2330	2.20	− 203	−0.19
Sept.	3.46	3.40	3.42	−0.24	− 254	2298	2.17	2044	1.93	2178	2.06	− 134	−0.13
Oct.	3.22	3.05	3.13	−0.27	− 286	2227	2.11	1941	1.84	2168	2.05	− 227	−0.21
Nov.	2.95	2.85	3.04	−0.06	− 63	2206	2.09	2143	2.03	2088	1.97	+ 55	+0.05
Dec.	2.89	2.93	3.31	−0.17	− 180	2271	2.15	2091	1.98	1855	1.75	+ 236	+0.22
1879													
Jan.	2.72	2.51	2.76	−0.28	− 296	2137	2.02	1841	1.74	1771	1.67	+ 70	+0.07
Feb.	2.44	2.37	2.40	−0.06	− 63	2055	1.94	1992	1.88	1482	1.40	+ 510	+0.48
Mar.	2.38	2.40	2.38	+0.20	+ 211	2051	1.94	2262	2.14	1849	1.75	+ 413	+0.39
April	2.58	2.76	2.67	+0.26	+ 275	2118	2.00	2393	2.26	2062	1.95	+ 331	+0.31
May	2.84	2.91	2.81	+0.12	+ 127	2149	2.03	2276	2.15	1950	1.84	+ 326	+0.31
June	2.96	3.00	2.97	+0.06	+ 63	2187	2.07	2250	2.13	2078	1.97	+ 172	+0.16
July	3.02	3.03	3.07	−0.10	− 106	2213	2.09	2107	1.99	2104	1.99	+ 3	0.00
Aug.	2.92	2.81	2.77	−0.28	− 296	2140	2.02	1844	1.74	2052	1.94	− 208	−0.20
Sept.	2.64	2.48	2.50	−0.28	− 296	2077	1.96	1781	1.68	2058	1.95	− 277	−0.26
Oct.	2.36	2.25	2.33	−0.34	− 360	2038	1.93	1678	1.59	1961	1.85	− 283	−0.27
Nov.	2.02	1.78	1.97	−0.11	− 116	1956	1.85	1840	1.74	1978	1.87	− 138	−0.13
Dec.	1.91	2.04	2.42	+0.38	+ 402	2059	1.95	2461	2.33	1956	1.85	+ 505	+0.48

a.—Discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

DATE	WATER LEVELS OF LAKE ERIE			STORAGE IN LAKE ERIE		OUTFLOW THROUGH NIAGARA RIVER. *a*		TOTAL SUPPLY TO LAKE ERIE		INFLOW FROM DETROIT RIVER		LOCAL SUPPLY TO LAKE ERIE.	
	CLEVELAND, O.		Buffalo, N.Y. Mean of Month.										
	First of Month	Mean of Month.		Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1800													
Jan.	572.29	572.54	572.79	+0.27	+ 286	2146	2.03	2432	2.30	1931	1.83	+ 501	+0.47
Feb.	2.56	2.58	2.61	+0.09	+ 95	2103	1.99	2198	2.08	1709	1.62	+ 489	+0.46
Mar.	2.65	2.72	2.70	+0.15	+ 159	2124	2.01	2283	2.16	1903	1.80	+ 380	+0.36
April	2.80	2.88	2.79	+0.22	+ 233	2145	2.03	2378	2.25	1974	1.87	+ 404	+0.38
May	3.02	3.15	3.05	+0.18	+ 190	2207	2.09	2397	2.27	1983	1.88	+ 414	+0.39
June	3.20	3.26	3.23	+0.10	+ 106	2251	2.13	2357	2.23	2176	2.06	+ 181	+0.17
July	3.30	3.35	3.39	−0.07	− 74	2291	2.17	2217	2.10	2095	1.98	+ 122	+0.12
Aug.	3.23	3.11	3.07	−0.23	− 243	2213	2.09	1970	1.86	2216	2.10	− 246	−0.23
Sept.	3.00	2.88	2.90	−0.34	− 360	2172	2.05	1812	1.71	2153	2.04	− 341	−0.32
Oct.	2.66	2.44	2.52	−0.26	− 275	2081	1.97	1806	1.71	2089	1.98	− 283	−0.27
Nov.	2.40	2.36	2.55	−0.21	− 222	2088	1.97	1866	1.76	2058	1.95	− 192	−0.18
Dec.	2.19	2.02	2.40	−0.37	− 391	2055	1.94	1664	1.57	2054	1.94	− 390	−0.37
1881													
Jan.	1.82	1.61	1.86	−0.16	− 169	1931	1.83	1762	1.67	1756	1.66	+ 6	+0.01
Feb.	1.66	1.72	1.75	+0.22	+ 233	1908	1.80	2141	2.02	1968	1.86	+ 173	+0.16
Mar.	1.88	2.04	2.02	+0.51	+ 539	1968	1.86	2507	2.37	1891	1.79	+ 616	+0.58
April	2.39	2.74	2.65	+0.55	+ 582	2112	2.00	2694	2.55	2025	1.92	+ 669	+0.63
May	2.94	3.14	3.04	+0.32	+ 338	2205	2.09	2543	2.40	2083	1.97	+ 460	+0.44
June	3.26	3.38	3.35	+0.10	+ 106	2281	2.16	2387	2.26	2182	2.06	+ 205	+0.19
July	3.36	3.33	3.37	−0.19	− 201	2286	2.16	2085	1.97	2178	2.06	− 92	−0.09
Aug.	3.17	3.01	2.97	−0.33	− 349	−2188	2.07	1839	1.74	2209	2.09	− 370	−0.35
Sept.	2.84	2.66	2.68	−0.20	− 211	2119	2.00	1908	1.80	2247	2.12	− 339	−0.32
Oct.	2.64	2.61	2.69	−0.12	− 127	2121	2.01	1994	1.89	2137	2.02	− 143	−0.14
Nov.	2.52	2.43	2.62	+0.02	+ 21	2105	1.99	2126	2.01	2288	2.16	− 162	−0.15
Dec.	2.54	2.64	3.02	+0.34	+ 360	2200	2.08	2560	2.42	2232	2.11	+ 328	+0.31
1882													
Jan.	2.88	3.11	3.36	+0.23	+ 243	2283	2.16	2526	2.39	2225	2.10	+ 301	+0.28
Feb.	3.11	3.11	3.14	+0.23	+ 243	2229	2.11	2472	2.34	2045	1.93	+ 427	+0.40
Mar.	3.34	3.56	3.54	+0.33	+ 349	2330	2.20	2679	2.53	2194	2.07	+ 485	+0.46
April	3.67	3.78	3.69	+0.21	+ 222	2367	2.24	2589	2.45	2182	2.06	+ 407	+0.38
May	3.88	3.98	3.88	+0.18	+ 190	2416	2.28	2606	2.46	2368	2.24	+ 238	+0.23
June	4.06	4.13	4.10	+0.04	+ 42	2474	2.34	2516	2.38	2206	2.09	+ 310	+0.29
July	4.10	4.06	4.10	−0.11	− 116	2474	2.34	2358	2.23	2580	2.44	− 222	−0.21
Aug.	3.99	3.92	3.88	−0.21	− 222	2416	2.28	2194	2.07	2615	2.47	− 421	−0.40
Sept.	3.78	3.65	3.67	−0.36	− 381	2362	2.23	1981	1.87	2321	2.19	− 340	−0.32
Oct.	3.42	3.20	3.28	−0.38	− 402	2265	2.14	1863	1.76	2271	2.15	− 408	−0.39
Nov.	3.04	2.88	3.07	−0.42	− 444	2213	2.09	1769	1.67	2251	2.13	− 482	−0.46
Dec.	2.62	2.37	2.75	−0.30	− 317	2135	2.02	1818	1.72	*b*2139	2.02	− 321	−0.30
1883													
Jan.	2.32	2.28	2.53	+0.06	+ 63	2084	1.97	2147	2.03	*b*2238	2.12	− 91	−0.09
Feb.	2.38	2.49	2.52	+0.20	+ 211	2081	1.97	2292	2.17	2228	2.11	+ 64	+0.06
Mar.	2.58	2.68	2.66	+0.16	+ 169	2115	2.00	2284	2.16	1856	1.76	+ 428	+0.40
April	2.74	2.80	2.71	+0.29	+ 307	2126	2.01	2433	2.30	2156	2.04	+ 277	+0.26
May	3.03	3.26	3.16	+0.58	+ 613	2234	2.11	2847	2.69	2230	2.11	+ 617	+0.58
June	3.61	3.96	3.93	+0.45	+ 476	2427	2.30	2903	2.75	2434	2.30	+ 469	+0.44
July	4.06	4.16	4.20	+0.07	+ 74	2500	2.36	2574	2.43	2754	2.60	− 180	−0.17
Aug.	4.13	4.10	4.06	−0.19	− 201	2462	2.33	2261	2.14	2716	2.57	− 455	−0.43
Sept.	3.94	3.79	3.81	−0.31	− 328	2397	2.27	2069	1.96	2538	2.40	− 469	−0.44
Oct.	3.63	3.47	3.55	−0.35	− 370	2332	2.21	1962	1.86	2402	2.27	− 440	−0.42
Nov.	3.28	3.09	3.28	−0.18	− 190	2265	2.14	2075	1.96	2307	2.18	− 232	−0.22
Dec.	3.10	3.12	3.50	−0.14	− 148	2320	2.19	2172	2.05	2211	2.09	− 39	−0.04
1884													
Jan.	2.96	2.79	3.04	−0.04	− 42	2206	2.09	2164	2.05	1514	1.43	+ 650	+0.61
Feb.	2.92	3.05	3.08	+0.22	+ 233	2215	2.09	2448	2.32	1703	1.61	+ 745	+0.70
Mar.	3.14	3.24	3.22	+0.38	+ 402	2248	2.13	2650	2.51	2426	2.29	+ 224	+0.21
April	3.52	3.79	3.70	+0.40	+ 423	2370	2.24	2793	2.64	2428	2.30	+ 364	+0.35
May	3.92	4.06	3.96	+0.18	+ 190	2436	2.30	2626	2.48	2444	2.31	+ 182	+0.17
June	4.10	4.14	4.11	−0.07	− 74	2475	2.34	2401	2.27	2531	2.39	− 130	−0.12
July	4.03	3.92	3.96	−0.19	− 201	2436	2.30	2235	2.11	2611	2.47	− 376	−0.36
Aug.	3.84	3.76	3.72	−0.30	− 317	2375	2.25	2058	1.95	2489	2.35	− 431	−0.41
Sept.	3.54	3.33	3.35	−0.38	− 402	2281	2.16	1879	1.78	2410	2.28	− 531	−0.50
Oct.	3.16	3.00	3.08	−0.40	− 423	2215	2.09	1792	1.69	2367	2.24	− 575	−0.54
Nov.	2.76	2.52	2.71	−0.28	− 296	2126	2.01	1830	1.73	2336	2.21	− 506	−0.48
Dec.	2.48	2.45	2.83	−0.12	− 127	2155	2.04	2028	1.92	2384	2.25	− 356	−0.34

a.—Discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

DATE	WATER LEVELS OF LAKE ERIE			STORAGE IN LAKE ERIE		OUTFLOW THROUGH NIAGARA RIVER. *a*		TOTAL SUPPLY TO LAKE ERIE		INFLOW FROM DETROIT RIVER		LOCAL SUPPLY TO LAKE ERIE.	
	CLEVELAND, O.		Buffalo, N.Y. Mean of Month.										
	First of Month	Mean of Month.		Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1885													
Jan.	572.36	572.27	572.52	−0.20	− 211	2081	1.97	1870	1.77	*b*2398	2.27	− 528	−0.50
Feb.	2.16	2.06	2.09	−0.17	− 180	1984	1.88	1804	1.71	2352	2.22	− 548	−0.52
Mar.	1.99	1.92	1.90	+0.34	+ 360	1941	1.84	2301	2.18	*b*2364	2.24	− 63	−0.06
April	2.33	2.74	2.65	+0.77	+ 814	2112	2.00	2926	2.77	*b*2287	2.15	+ 639	+0.60
May	3.10	3.47	3.37	+0.62	+ 656	2286	2.16	2942	2.78	2386	2.26	+ 556	+0.53
June	3.72	3.98	3.95	+0.24	+ 254	2434	2.30	2688	2.54	2445	2.31	+ 243	+0.23
July	3.96	3.94	3.98	−0.02	− 21	2441	2.31	2420	2.29	2376	2.25	+ 44	+0.04
Aug.	3.94	3.95	3.91	−0.06	− 63	2423	2.29	2360	2.23	2432	2.30	− 72	−0.07
Sept.	3.88	3.80	3.82	−0.13	− 137	2400	2.27	2263	2.14	2396	2.27	− 133	−0.13
Oct.	3.75	3.70	3.78	−0.11	− 116	2390	2.26	2274	2.15	2217	2.10	+ 57	+0.05
Nov.	3.64	3.58	3.77	0.08	− 85	2387	2.26	2302	2.18	2276	2.15	+ 26	+0.02
Dec.	3.56	3.53	3.91	−0.02	− 21	2423	2.29	2402	2.27	2204	2.08	+ 198	+0.19
1886													
Jan.	3.54	3.55	3.80	−0.36	− 381	2395	2.26	2014	1.90	1677	1.59	+ 337	+0.32
Feb.	3.18	2.82	2.85	−0.46	− 486	2159	2.04	1673	1.58	1490	1.41	+ 183	+0.17
Mar.	2.72	2.63	2.61	+0.35	+ 370	2103	1.99	2473	2.34	2008	1.90	+ 465	+0.44
April	3.07	3.51	3.42	+0.59	+ 624	2298	2.17	2922	2.76	2118	2.00	+ 804	+0.76
May	3.66	3.81	3.71	+0.20	+ 211	2372	2.24	2583	2.44	2428	2.30	+ 155	+0.15
June	3.86	3.91	3.88	+0.04	+ 42	2416	2.28	2458	2.32	2432	2.30	+ 26	+0.02
July	3.90	3.89	3.93	−0.11	− 116	2428	2.30	2312	2.19	2418	2.29	− 106	−0.10
Aug.	3.79	3.69	3.65	−0.23	− 243	2357	2.23	2114	2.00	2406	2.28	− 292	−0.28
Sept.	3.56	3.44	3.46	−0.24	− 254	2307	2.18	2053	1.94	2403	2.27	− 350	−0.33
Oct.	3.32	3.21	3.29	−0.26	− 275	2267	2.14	1992	1.88	2364	2.24	− 372	−0.35
Nov.	3.06	2.92	3.11	−0.18	− 190	2222	2.10	2032	1.92	2298	2.17	− 266	−0.25
Dec.	2.88	2.83	3.21	−0.16	− 169	−2246	2.12	2077	1.96	2403	2.27	− 326	−0.31
1887													
Jan.	2.72	2.61	2.86	+0.10	+ 106	2161	2.04	2267	2.14	2289	2.16	− 22	−0.02
Feb.	2.82	3.04	3.07	+0.61	+ 645	2212	2.09	2857	2.70	2253	2.13	+ 604	+0.57
Mar.	3.43	3.82	3.75	+0.41	+ 434	2383	2.25	2817	2.66	1985	1.88	+ 832	+0.79
April	3.84	3.87	3.71	+0.12	+ 127	2372	2.24	2499	2.36	2133	2.02	+ 366	+0.35
May	3.96	4.05	3.93	+0.10	+ 106	+2427	2.30	2533	2.40	2202	2.08	+ 331	+0.31
June	4.06	4.07	4.07	−0.10	− 106	2465	2.33	2359	2.23	2261	2.14	+ 98	+0.09
July	3.96	3.84	3.91	−0.28	− 296	2423	2.29	2127	2.01	2319	2.19	− 192	−0.18
Aug.	3.68	3.52	3.51	−0.28	− 296	2322	2.20	2026	1.92	2316	2.19	− 290	−0.27
Sept.	3.40	3.29	3.20	−0.40	− 423	2244	2.12	1821	1.72	2233	2.11	− 412	−0.39
Oct.	3.00	2.70	3.26	−0.44	− 465	2258	2.14	1793	1.70	2217	2.10	− 424	−0.40
Nov.	2.56	2.43	2.71	−0.12	− 127	2125	2.01	1998	1.89	2109	1.99	− 111	−0.10
Dec.	2.44	2.45	2.89	−0.08	− 85	2170	2.05	2085	1.97	2016	1.91	+ 69	+0.07
1888													
Jan.	2.36	2.27	2.57	−0.22	− 233	2094	1.98	1861	1.76	2090	1.98	− 229	−0.22
Feb.	2.14	2.00	1.96	−0.09	− 95	1954	1.85	1859	1.76	2086	1.97	− 227	−0.21
Mar.	2.05	2.10	2.03	+0.37	+ 391	1971	1.86	2362	2.23	1922	1.82	+ 440	+0.42
April	2.42	2.73	2.69	+0.44	+ 465	2121	2.01	2586	2.45	2104	1.99	+ 482	+0.46
May	2.86	2.98	2.84	+0.18	+ 190	2157	2.04	2347	2.22	2036	1.93	+ 311	+0.29
June	3.04	3.11	3.01	+0.14	+ 148	2197	2.08	2345	2.22	2120	2.00	+ 225	+0.21
July	3.18	3.26	3.23	+0.03	+ 32	2251	2.13	2283	2.16	2208	2.09	+ 75	+0.07
Aug.	3.21	3.16	3.12	−0.27	− 286	2225	2.10	1939	1.83	2177	2.06	− 238	−0.23
Sept.	2.94	2.72	2.78	−0.40	− 423	2142	2.03	1719	1.63	2186	2.07	− 467	−0.44
Oct.	2.54	2.35	2.59	−0.16	− 169	2098	1.98	1929	1.82	2131	2.02	− 202	−0.19
Nov.	2.38	2.41	2.44	−0.03	− 32	2064	1.95	2032	1.92	2079	1.97	− 47	−0.04
Dec.	2.35	2.29	2.74	−0.05	− 53	2133	2.02	2080	1.97	1992	1.88	+ 88	+0.08
1889													
Jan.	2.30	2.31	2.56	−0.07	− 74	2091	1.98	2017	1.91	2099	1.99	− 82	−0.08
Feb.	2.23	2.15	2.34	−0.16	− 169	2041	1.93	1872	1.77	1701	1.61	+ 171	−0.16
Mar.	2.07	1.99	1.95	+0.09	+ 95	1952	1.85	2047	1.94	1716	1.62	+ 331	+0.31
April	2.16	2.24	3.33	+0.27	+ 286	2038	1.93	2324	2.20	1792	1.69	+ 532	+0.50
May	2.43	2.52	2.49	+0.31	+ 328	2075	1.96	2403	2.27	1934	1.83	+ 469	+0.44
June	2.74	2.95	2.96	+0.31	+ 328	2186	2.07	2514	2.38	2100	1.99	+ 414	+0.39
July	3.05	3.15	3.00	−0.05	− 53	2196	2.08	2143	2.03	2086	1.97	+ 57	+0.05
Aug.	3.00	2.84	2.91	−0.36	− 381	2174	2.06	1793	1.70	2097	1.98	− 304	−0.29
Sept.	2.64	2.45	2.53	−0.40	− 423	2084	1.97	1661	1.57	2113	2.00	− 452	−0.43
Oct.	2.24	2.03	2.03	−0.34	− 360	1970	1.86	1610	1.52	2020	1.91	− 410	−0.39
Nov.	1.90	1.76	2.03	−0.01	− 11	1970	1.86	1959	1.85	1988	1.88	− 29	−0.03
Dec.	1.89	2.02	2.34	+0.31	+ 328	2041	1.93	2369	2.24	1817	1.72	+ 552	+0.52

a.—Discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

DATE	WATER LEVELS OF LAKE ERIE			STORAGE IN LAKE ERIE		OUTFLOW THROUGH NIAGARA RIVER. *a*		TOTAL SUPPLY TO LAKE ERIE		INFLOW FROM DETROIT RIVER		LOCAL SUPPLY TO LAKE ERIE.	
	CLEVELAND, O.		Buffalo, N.Y.										
	First of Month	Mean of Month.	Mean of Month.	Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Deptb, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1890													
Jan.	572 20	572 38	572.93	+0.32	+ 338	2178	2.06	2516	2.38	1940	1.83	+ 576	+0.54
Feb.	2.52	2.67	2.74	+0.21	+ 222	2133	2.02	2355	2.23	1797	1.70	+ 558	+0.53
Mar.	2.73	2.79	2.98	+0.31	+ 328	2191	2.07	2519	2.38	1745	1.65	+ 774	+0.73
April	3.04	3.28	3.23	+0.41	+ 434	2251	2.13	2685	2.54	1823	1.72	+ 862	+0.82
May	3.45	3.62	3.59	+0.35	+ 370	2342	2.21	2712	2.56	1839	1.74	+ 873	+0.83
June	3.80	3 99	3.92	0.00	0	2426	2.29	2426	2.29	1964	1.86	+ 462	+0.44
July	3 80	3.61	3.64	−0.42	− 444	2354	2.23	1910	1.81	2046	1.93	− 136	−0.13
Aug.	3.38	3.15	3.17	−0.32	− 338	2237	2.12	1899	1.80	2066	1.95	− 167	−0.16
Sept.	3.06	2.98	2.82	−0.18	− 190	2152	2.04	1962	1.86	1994	1.89	− 32	−0.03
Oct.	2.88	2.79	2.81	−0.10	− 106	2150	2.03	2044	1.93	1919	1.81	+ 125	+0.12
Nov.	2 78	2.76	3.00	−0.14	− 148	2196	2.08	2048	1.94	1950	1.84	+ 98	+0.09
Dec.	2 64	2.53	2.74	−0.22	− 233	2133	2.02	1900	1.80	1875	1.77	+ 25	+0.02
1891													
Jan.	2 42	2.31	2 48	−0.12	− 127	2072	1 96	1945	1.84	1718	1.62	+ 227	+0.22
Feb.	2.30	2.29	2.36	+0.22	+ 233	2046	1.93	2279	2.16	1809	1 71	+ 470	+0.44
Mar.	2.52	2.75	2.50	+0.16	+ 169	2077	1.96	2246	2.12	1534	1.45	− 712	+0.67
April	2 68	2.62	2.62	−0.15	− 159	2106	1.99	1947	1.84	1830	1.73	− 117	+0.11
May	2 53	2.44	2.40	−0.02	− 21	2054	1.94	2033	1.92	1865	1.76	+ 168	+0.16
June	2.51	2.58	2.38	+0.02	+ 21	2050	1.94	2071	1.96	1885	1.78	+ 186	+0.18
July	2.53	2.48	2.56	−0.19	− 201	2091	1.98	1890	1.79	1931	1.83	− 41	−0.04
Aug.	2.34	2.21	2 27	−0.22	− 233	2025	1.92	1792	1.69	1952	1.85	− 160	−0.15
Sept.	2.12	2.03	2.10	−0.28	− 296	1986	1.88	1690	1.60	1943	1.84	− 253	−0.24
Oct.	1 84	1.65	1.73	−0.41	− 434	1903	1.80	1469	1.39	1878	1.78	− 409	−0.39
Nov.	1.43	1.21	1.67	−0.19	− 201	1891	1.79	1690	1.60	1912	1.81	− 222	−0.21
Dec.	1.24	1.28	1.70	+0.06	+ 63	1897	1.79	1960	1.85	1873	1.77	+ 87	+0.08
1892													
Jan.	1.30	1.31	1.61	−0.10	− 106	1878	1.78	1772	1.68	1683	1 59	+ 89	+0.08
Feb.	2.20	1.10	0.92	−0.08	− 85	1733	1.64	1648	1.56	1425	1.35	+ 223	+0.21
Mar.	1.12	1.14	1.12	+0.30	+ 317	1775	1.68	2092	1.98	1508	1.43	+ 584	+0.55
April	1.42	1.70	1.96	+0.68	+ 719	1954	1.85	2673	2.53	1767	1.67	+ 906	+0.86
May	2.10	2.50	2 40	+0.78	+ 825	2054	1.94	2879	2.72	1787	1.69	+1092	+1.03
June	2.88	3.26	3.21	+0.44	+ 465	2246	2.12	2711	2.56	1864	1.76	+ 847	+0.80
July	3.32	3.38	3.42	−0.12	− 127	2299	2.17	2172	2.05	1908	1.80	+ 264	+0.25
Aug.	3.20	3.03	3.05	−0.33	− 349	2208	2.09	1859	1.76	1926	1.82	− 67	−0.06
Sept.	2.87	2.71	2.78	−0.44	− 465	2143	2.03	1678	1.59	1981	1.87	− 303	−0.29
Oct.	2.43	2.15	2.45	−0.45	− 476	2066	1.95	1590	1.50	1905	1.80	− 315	−0.30
Nov.	1 98	1.82	2.07	−0.30	− 317	1978	1.87	1661	1.57	1843	1.74	− 182	−0.17
Dec.	1 68	1.55	2.04	−0.32	− 338	1973	1.87	1635	1.55	1753	1.66	118	−0.11
1893													
Jan.	1.36	1.17	1.27	−0.15	− 159	1806	1.71	1647	1.56	1464	1.38	+ 183	+0.17
Feb.	1 21	1.25	1.22	+0.15	+ 159	1796	1.70	1955	1.85	1514	1.43	+ 441	+0.42
Mar.	1.36	1.47	1.53	+0.48	+ 508	1861	1.76	2369	2.24	1851	1.75	+ 518	+0.49
April	1.84	2.20	2.19	+0.78	+ 825	2006	1.90	2831	2.68	1883	1.78	+ 948	+0.90
May	2.62	3.04	2.91	+0.52	+ 550	2174	2.06	2724	2.58	1817	1.72	+ 907	+0.86
June	3.14	3.23	3.26	−0.05	− 53	2258	2.14	2205	2.09	1950	1.84	+ 255	+0.24
July	3.09	2.95	3.13	−0.31	− 328	2224	2.10	1896	1.79	2047	1.94	− 151	−0.14
Aug.	2.78	2.61	2.54	−0.36	− 381	2086	1.97	1705	1.61	2052	1.94	− 347	−0.33
Sept.	2.42	2.23	2.29	−0.36	− 381	2028	1.92	1647	1.56	2034	1.92	− 387	−0.37
Oct.	2.06	1.88	2.19	−0.38	− 402	−2006	1.90	1604	1.52	1988	1.88	− 384	−0.36
Nov.	1.68	1.48	2.17	−0.16	− 169	2001	−1.89	1832	1.73	1990	1.88	− 158	−0.15
Dec.	1.52	1.56	2.13	+0.18	+ 190	1993	1.88	2183	2.06	1958	1.85	+ 225	+0.21
1894													
Jan.	1.70	1 84	2.13	+0.08	+ 85	1993	1.88	2078	1.97	1876	1.77	+ 202	+0.19
Feb.	1.78	1.72	1.75	−0.04	− 42	1908	1.80	1866	1.76	1698	1.61	+ 168	+0.16
Mar.	1.74	1.75	1.86	+0.21	+ 222	1931	1.83	2153	2.04	1877	1.78	+ 276	+0.26
April	1.95	2.15	2.05	+0.39	+ 412	1974	1.87	2386	2.26	1867	1.77	+ 519	+0.49
May	2.34	2.54	2.55	+0.30	+ 317	2088	1.97	2405	2.27	1981	1.87	+ 424	+0.40
June	2.64	2.75	2.94	+0.10	+ 106	2181	2.06	2287	2.16	2045	1.93	+ 242	+0.23
July	2.74	2.73	2.81	−0.20	− 211	2150	2.03	1939	1.83	2048	1.94	− 109	−0.10
Aug.	2.54	2.36	2.34	−0.26	− 275	2040	1.93	1765	1.67	2051	1.94	− 286	−0.27
Sept.	2.28	2.19	2.17	−0.25	− 264	2002	1.89	1738	1.64	2026	1.92	− 288	−0.27
Oct.	2.03	1.87	2.17	−0.28	− 296	2002	1.89	1706	1.61	1971	1.86	− 265	−0.25
Nov.	1.75	1.63	1.99	−0.15	− 159	1962	1.86	1803	1.71	1952	1.85	− 149	−0.14
Dec.	1.60	1.56	1.82	−0.20	− 211	1923	1.82	1712	1.62	1882	1.78	− 170	−0.16

a.—Discharge values include flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

DATE	WATER LEVELS OF LAKE ERIE			STORAGE IN LAKE ERIE		OUTFLOW THROUGH NIAGARA RIVER. *a*		TOTAL SUPPLY TO LAKE ERIE		INFLOW FROM DETROIT RIVER		LOCAL SUPPLY TO LAKE ERIE.	
	CLEVELAND, O.		Buffalo, N.Y., Mean of Month.										
	First of Month	Mean of Month.		Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1895													
Jan.	571.40	571.23	571.69	−0.28	− 296	1896	1.79	1600	1.51	*b*1878	1.78	− 278	−0 26
Feb.	1.12	1.00	1.00	−0.12	− 127	1749	1.65	1622	1.53	*b*1842	1.74	− 220	−0.21
Mar.	1.00	1.01	0.92	+0.14	+ 148	1733	1.64	1881	1.78	1988	1.88	− 107	−0.10
April	1.14	1.26	1.13	+0.23	+ 243	1777	1.68	2020	1.91	1732	1.64	+ 288	+0.27
May	1.37	1.48	1.48	+0.15	+ 159	1850	1.75	2009	1.90	1814	1.72	+ 195	+0.18
June	1.52	1.57	1.58	0.00	0	1872	1.77	1872	1.77	1861	1.76	+ 11	+0.01
July	1.52	1.46	1.56	−0.10	− 106	1867	1.77	1761	1.67	1898	1.79	− 137	−0.13
Aug.	1.42	1.38	1.42	−0.09	− 95	1838	1.74	1743	1.65	1895	1.79	− 152	−0.14
Sept.	1.33	1.28	1.44	−0.29	− 307	1842	1.74	1535	1.45	1868	1.77	− 333	−0.31
Oct.	1.04	0.80	1.20	−0.29	− 307	1792	1.69	1485	1.40	1794	1.70	− 309	−0.29
Nov.	0.75	0.70	0.71	+0.03	+ 32	1691	1.60	1723	1 63	1722	1.63	+ 1	0.00
Dec.	0.78	0.86	0.97	+0.13	+ 137	1744	1.65	1881	1.78	1748	1.65	+ 133	+0.13
1896													
Jan.	0.91	0.96	1.12	+0.01	+ 11	1775	1.68	1786	1.69	1736	1.64	+ 50	+0.05
Feb.	0.92	0.88	1.05	−0.06	− 63	1760	1.66	1697	1.60	1410	1.33	+ 287	+0 27
Mar	0.86	0.83	0.69	+0.20	+ 211	1687	1.60	1898	1.79	1540	1.46	+ 358	+0.34
April	1.06	1.28	1.22	+0.41	+ 434	1796	1.70	2230	2.11	1681	1.59	+ 549	+0 52
May	1.47	1.66	1.67	+0.33	+ 349	1891	1.79	2240	2.12	1688	1.60	+ 552	+0.52
June	1.80	1.93	1.68	+0.07	+ 74	1893	1.79	1967	1.86	1791	1 69	+ 176	+0.17
July	1.87	1.81	1.86	+0.05	+ 53	1932	1.83	1985	1.88	1888	1.79	+ 97	+0.09
Aug.	1.92	2.02	2.09	−0.06	− 63	1983	1.88	1920	1.82	1898	1.79	+ 22	+0.02
Sept.	1.86	1.70	1.67	−0.28	− 296	1891	1.79	1595	1.51	1837	1.74	− 242	−0.23
Oct.	1.58	1.46	1.41	−0.30	− 317	1836	1.74	1519	1.44	1842	1.74	− 323	−0.31
Nov.	1.28	1.09	1.44	−0.18	− 190	1842	1.74	1652	1.56	1840	1.74	− 188	−0.18
Dec.	1.10	1.12	1.23	0.00	0	1797	1.70	1797	1.70	1683	1.59	+ 114	+0.11
1897													
Jan.	1.10	1.09	1.59	+0.09	+ 95	1875	1.77	1970	1.86	1925	1.82	+ 45	+0.04
Feb.	1.19	1.29	1.15	+0.29	+ 307	1781	1.68	2088	1.97	*b*1784	1.69	+ 304	+0.29
Mar.	1.48	1.66	1.66	+0.46	+ 486	1888	1.79	2374	2.25	1907	1.80	+ 467	+0.44
April	1.94	2.21	2.18	+0.44	+ 465	2004	1.90	2469	2.33	1849	1.75	+ 620	+0.59
May	2.38	2.54	2.60	+0.21	+ 222	2101	1.99	2323	2.20	1950	1.84	+ 373	+0.35
June	2.59	2.64	2.59	+0.05	+ 53	2097	1.98	2150	2.03	1871	1.77	+ 279	+0.26
July	2.64	2.63	2.57	−0.09	− 95	2093	1.98	1998	1.89	1931	1.83	+ 67	+0.06
Aug.	2.55	2.47	2.45	−0.22	− 233	2066	1.95	1833	1.73	1932	1.83	− 99	−0.09
Sept.	2.33	2.19	2.09	−0.39	− 412	1984	1.88	1572	1.49	1926	1.82	− 354	−0.33
Oct.	1.94	1.70	1.65	−0.30	− 317	1886	1.78	1569	1.48	1898	1.79	− 329	−0.31
Nov.	1.64	1.57	1.69	−0.08	− 85	1895	1.79	1810	1.71	1916	1.81	− 106	−0.10
Dec.	1.56	1.54	1.81	0.00	0	1921	1.82	1921	1.82	1807	1.71	+ 114	+0.11
1898													
Jan.	1.56	1.59	1.68	+0.13	+ 137	1893	1.79	2030	1.92	1756	1.66	+ 274	+0 26
Feb.	1.69	1.79	1.57	+0.23	+ 243	1870	1.77	2113	2.00	1482	1.40	+ 631	+0.60
Mar.	1.92	2.05	1.95	+0.42	+ 444	1951	1.85	2395	2.26	1888	1.79	+ 507	+0 48
April	2.34	2.63	2.55	+0.36	+ 381	2088	1.97	2469	2.33	1848	1.75	+ 621	+0.59
May	2.70	2.78	2.68	+0.10	+ 106	2119	2.00	2225	2.10	1818	1.72	+ 407	+0.38
June	2.80	2.81	2.72	−0.10	− 106	2128	2.01	2022	1.91	1893	1.79	+ 129	+0.12
July	2.70	2.59	2.50	−0.21	− 222	2077	1.96	1855	1.75	1986	1.88	− 131	−0 12
Aug.	2.49	2.39	2.46	−0.29	− 307	2068	1.96	1761	1.67	1931	1.83	− 170	−0 16
Sept.	2.20	2.61	2.08	−0.29	− 307	1981	1.87	1674	1.58	1964	1.86	− 290	−0.27
Oct.	1.91	1.81	1.91	−0.16	− 169	1943	1.84	1774	1.68	1896	1.79	− 122	−0.12
Nov.	1.75	1.69	2.01	−0.15	− 159	1965	1.86	1806	1.71	1969	1.86	− 163	−0.15
Dec.	1 60	1.52	2.07	0.00	0	1978	1.87	1978	1.87	1996	1.89	− 18	−0.02
1899													
Jan.	1.60	1.67	2.05	−0.04	− 42	1974	1.87	1932	1.83	1947	1.84	− 15	−0.01
Feb.	1.56	1.46	1.59	+0.08	+ 85	1875	1.77	1960	1.85	*b*1856	1.76	+ 104	+0.10
Mar.	1.64	1.83	1.85	+0.34	+ 360	1929	1.82	2289	2.16	1366	1.29	+ 923	+0.87
April	1.98	2.13	2.04	+0.30	+ 317	1973	1.87	2290	2.17	1655	1.57	+ 635	+0.60
May	2.28	2.44	2.32	+0.22	+ 233	2036	1.93	2269	2.15	1812	1.71	+ 457	+0.43
June	2.50	2.56	2.51	−0.08	− 85	2079	1.97	1994	1.89	1935	1.83	+ 59	+0.06
July	2.42	2.28	2.45	−0.24	− 254	2066	1.95	1812	1.71	2022	1.91	− 210	−0.20
Aug.	2.18	2.09	2.09	−0.21	− 222	1983	1.88	1761	1.67	2031	1.92	− 270	−0.26
Sept.	1.97	1.85	1.90	−0.24	− 254	1941	1.84	1687	1.60	2015	1.91	− 328	−0.31
Oct.	1.73	1.61	1.48	−0.11	− 116	1850	1.75	1734	1.64	1923	1.82	− 189	−0.18
Nov.	1.62	1.62	1.55	−0.14	− 148	1866	1.76	1718	1.62	1883	1.78	− 165	−0.16
Dec.	1.48	1.34	1.96	−0.13	− 137	1954	1.85	1817	1.72	1822	1.72	− 5	0 00

a.—Discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.
b.—St. Clair River discharge used.

SESSIONAL PAPER No. 54.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

DATE	WATER LEVELS OF LAKE ERIE			STORAGE IN LAKE ERIE		OUTFLOW THROUGH NIAGARA RIVER. *a*		TOTAL SUPPLY TO LAKE ERIE		INFLOW FROM DETROIT RIVER		LOCAL SUPPLY TO LAKE ERIE.	
	CLEVELAND, O.		Buffalo, N.Y. Mean of Month.										
	First of Month	Mean of Month.		Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1900													
Jan.	571.35	571.36	571.67	+0.11	+ 116	1891	1.79	2007	1.90	1736	1.64	+ 271	+0.26
Feb.	1.46	1.57	1.61	+0.28	+ 296	1878	1.78	2174	2.06	1778	1.68	+ 396	+0.37
Mar.	1.74	1.92	1.82	+0.34	+ 360	1923	1.82	2283	2.16	1874	1.77	+ 409	+0.39
April	2.08	2.23	2.16	+0.23	+ 243	1999	1.89	2242	2.12	1780	1.68	+ 462	+0.44
May	2.31	2.39	2.33	+0.12	+ 127	2038	1.93	2165	2.05	1796	1.70	+ 369	+0.35
June	2.43	2.47	2.41	−0.03	− 32	2056	1.94	2024	1.91	1868	1.77	+ 156	+0.15
July	2.40	2.34	2.43	−0.08	− 85	2061	1.95	1976	1.87	1932	1.83	+ 44	+0.04
Aug.	2.32	2.31	2.31	−0.17	− 180	2034	1.92	1854	1.75	1957	1.85	− 103	−0.10
Sept.	2.15	1.99	2.07	−0.28	− 296	1978	1.87	1682	1.59	1978	1.87	− 296	−0.28
Oct.	1.87	1.75	1.68	−0.25	− 264	1893	1.79	1629	1.54	1953	1.85	− 324	−0.31
Nov.	1.62	1.49	1.84	−0.15	− 159	1927	1.82	1768	1.67	1974	1.87	− 206	−0.19
Dec.	1.47	1.45	1.77	−0.07	− 74	1912	1.81	1838	1.74	1911	1.81	− 73	−0.07
1901													
Jan.	1.40	1.35	1.60	−0.22	− 233	1876	1.77	1643	1.55	1719	1.63	− 76	−0.07
Feb.	1.18	1.00	1.03	−0.24	− 254	1755	1.66	1501	1.42	1410	1.33	+ 91	+0.09
Mar.	0.94	0.88	0.82	+0.14	+ 148	1712	1.62	1860	1.76	1548	1.46	+ 312	+0.30
April	1.08	1.29	1.05	+0.22	+ 233	1760	1.66	1993	1.88	1161	1.10	+ 832	+0.79
May	1.30	1.31	1.17	+0.22	+ 233	1786	1.69	2019	1.91	1706	1.61	+ 313	+0.30
June	1.52	1.72	1.69	+0.30	+ 317	1896	1.79	2213	2.09	1986	1.88	+ 227	+0.21
July	1.82	1.91	1.88	+0.02	+ 21	1936	1.83	1957	1.85	2052	1.94	− 95	−0.09
Aug.	1.84	1.78	1.70	−0.10	− 106	1897	1.79	1791	1.69	2084	1.97	− 293	−0.28
Sept.	1.74	1.71	1.75	−0.22	− 233	1908	1.80	1675	1.58	2025	1.92	− 350	−0.33
Oct.	1.52	1.33	1.53	−0.28	− 296	1861	1.76	1565	1.48	1983	1.88	− 418	−0.40
Nov.	1.24	1.16	1.39	−0.06	− 63	1831	1.73	1768	1.67	1963	1.86	− 195	−0.18
Dec.	1.18	1.19	1.37	−0.04	− 42	1827	1.73	1785	1.69	1935	1.83	− 150	−0.14
1902													
Jan.	1.14	1.08	1.41	−0.28	− 296	1836	1.74	1540	1.46	1522	1.44	+ 18	+0.02
Feb.	0.86	0.63	0.79	−0.08	− 85	1706	1.61	1621	1.53	1464	1.38	+ 157	+0.15
Mar.	0.78	0.94	0.95	+0.44	+ 465	1739	1.64	2204	2.08	1827	1.73	+ 377	+0.36
April	1.22	1.49	1.50	+0.46	+ 486	1855	1.75	2341	2.21	1816	1.72	+ 525	+0.50
May	1.68	1.86	1.74	+0.31	+ 328	1906	1.80	2234	2.11	1818	1.72	+ 416	+0.39
June	1.99	2.12	2.05	+0.44	+ 465	1975	1.87	2440	2.31	1936	1.83	+ 504	+0.48
July	2.43	2.74	2.73	+0.30	+ 317	2130	2.01	2447	2.31	2054	1.94	+ 393	+0.37
Aug.	2.73	2.72	2.64	−0.18	− 190	2110	2.00	1920	1.82	2003	1.89	− 83	−0.08
Sept.	2.55	2.38	2.30	−0.21	− 222	2031	1.92	1809	1.71	1944	1.84	− 135	−0.13
Oct.	2.34	2.29	2.39	−0.18	− 190	2053	1.94	1863	1.76	1905	1.80	− 42	−0.04
Nov.	2.16	2.02	2.14	−0.24	− 254	1995	1.89	1741	1.65	1846	1.75	− 105	−0.10
Dec.	1.92	1.82	2.20	−0.15	− 159	2009	1.90	1850	1.75	1919	1.81	− 69	−0.07
1903													
Jan.	1.77	1.72	1.99	−0.06	− 63	1961	1.85	1898	1.79	1988	1.88	− 90	−0.09
Feb.	1.71	1.70	1.70	+0.28	+ 296	1897	1.79	2193	2.07	1851	1.75	+ 342	+0.32
Mar.	1.99	2.28	2.13	+0.67	+ 708	1992	1.88	2700	2.55	1837	1.74	+ 863	+0.82
April	2.66	3.05	2.83	+0.41	+ 434	2154	2.04	2588	2.45	1879	1.78	+ 709	+0.67
May	3.07	3.09	2.85	0.00	0	2159	2.04	2159	2.04	1803	1.71	+ 356	+0.34
June	3.07	3.05	2.95	−0.05	− 53	2184	2.07	2131	2.02	1911	1.81	+ 220	+0.21
July	3.02	2.98	2.99	−0.15	− 159	2194	2.07	2035	1.92	1958	1.85	+ 77	+0.17
Aug.	2.87	2.76	2.64	−0.19	− 201	2110	2.00	1909	1.81	1978	1.87	− 69	−0.07
Sept.	2.68	2.59	2.55	−0.26	− 275	2088	1.97	1813	1.71	1997	1.89	− 184	−0.17
Oct.	2.42	2.25	2.36	−0.41	− 434	2045	1.93	1611	1.52	1999	1.89	− 388	−0.37
Nov.	2.01	1.77	2.01	−0.47	− 497	1966	1.86	1469	1.39	1910	1.81	− 441	−0.42
Dec.	1.54	1.31	2.02	−0.29	− 307	1968	1.86	1661	1.57	2138	2.02	− 477	−0.45
1904													
Jan.	1.25	1.19	1.06	−0.01	− 11	1762	1.67	1751	1.66	1612	1.52	+ 139	+0.13
Feb.	1.24	1.28	1.30	+0.33	+ 349	1813	1.71	2162	2.04	1682	1.59	+ 480	+0.45
Mar.	1.57	1.86	1.86	+0.81	+ 857	1931	1.83	2788	2.64	*b*1825	1.73	+ 963	+0.91
April	2.38	2.91	2.89	+0.66	+ 698	2170	2.05	2868	2.71	2035	1.92	+ 833	+0.79
May	3.04	3.17	3.23	+0.20	+ 211	2252	2.13	2463	2.33	1902	1.80	+ 561	+0.53
June	3.24	3.32	3.49	+0.12	+ 127	2317	2.19	2444	2.31	2031	1.92	+ 413	+0.39
July	3.36	3.41	3.41	−0.10	− 106	2296	2.17	2190	2.07	2083	1.97	+ 107	+0.10
Aug.	3.26	3.10	3.12	−0.29	− 307	2225	2.10	1918	1.81	2103	1.99	− 185	−0.17
Sept.	2.97	2.84	2.84	−0.31	− 328	2157	2.04	1829	1.73	2079	1.97	− 250	−0.25
Oct.	2.66	2.49	2.61	−0.36	− 381	2103	1.99	1722	1.63	2035	1.92	− 313	−0.30
Nov.	2.30	2.12	2.31	−0.36	− 381	2033	1.92	1652	1.56	1992	1.88	− 340	−0.32
Dec.	1.94	1.77	2.13	−0.30	− 317	1993	1.88	1676	1.58	2019	1.91	− 343	−0.32

a.—Discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

DATE	WATER LEVELS OF LAKE ERIE			STORAGE IN LAKE ERIE		OUTFLOW THROUGH NIAGARA RIVER. *a*		TOTAL SUPPLY TO LAKE ERIE		INFLOW FROM DETROIT RIVER		LOCAL SUPPLY TO LAKE ERIE.	
	CLEVELAND, O.		Buffalo, N.Y. Mean of Month.										
	First of Month	Mean of Month.		Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1905													
Jan.	571.64	571.52	571.74	−0.22	− 233	1906	1.80	1673	1.58	1580	1.49	+ 93	+0.09
Feb.	1.42	1.31	1.23	−0.18	− 190	1797	1.70	1607	1.52	1534	1.45	+ 73	+0.07
Mar.	1.24	1.18	1.32	+0.26	+ 275	1816	1.72	2091	1.98	1676	1.58	+ 415	+0.39
April	1.50	1.83	1.79	+0.64	+ 677	1917	1.81	2594	2.45	1947	1.84	+ 647	+0.61
May	2.14	2.46	2.38	+0.58	+ 613	2049	1.94	2662	2.52	1922	1.82	+ 740	+0.70
June	2.72	2.98	2.97	+0.30	+ 317	2188	2.07	2505	2.37	2066	1.95	+ 439	+0.42
July	3.02	3.06	3.28	−0.06	− 63	2264	2.14	2201	2.08	2118	2.00	+ 83	+0.08
Aug.	2.96	2.87	3.06	−0.21	− 222	2209	2.09	1987	1.88	2124	2.01	− 137	−0.13
Sept.	2.75	2.63	2.86	−0.28	− 296	2161	2.04	1865	1.76	2094	1.98	− 229	−0.22
Oct.	2.47	2.31	2.65	−0.35	− 370	2112	2.00	1742	1.65	2052	1.94	− 310	−0.29
Nov.	2.12	1.93	2.29	−0.20	− 211	2029	1.92	1818	1.72	2004	1.90	− 186	−0.18
Dec.	1.92	1.92	2.45	+0.01	+ 11	2066	1.95	2077	1.96	1942	1.84	+ 135	+0.13
1906													
Jan.	1.93	1.94	2.33	+0.01	+ 11	2038	1.93	2049	1.94	1991	1.88	+ 58	+0.05
Feb.	1.94	1.93	1.88	−0.12	− 127	1936	1.83	1809	1.71	1548	1.46	+ 261	+0.25
Mar.	1.82	1.71	1.66	+0.10	+ 106	1889	1.79	1995	1.89	1600	1.51	+ 395	+0.37
April	1.92	2.13	2.06	+0.34	+ 360	1977	1.87	2337	2.21	1905	1.80	+ 432	+0.41
May	2.26	2.40	2.27	+0.24	+ 254	2025	1.92	2279	2.16	1993	1.88	+ 286	+0.27
June	2.50	2.60	2.49	+0.12	+ 127	2075	1.96	2202	2.08	2034	1.92	+ 168	+0.16
July	2.62	2.64	2.56	+0.02	+ 21	2091	1.98	2112	2.00	2089	1.98	+ 23	+0.02
Aug.	2.64	2.63	2.51	−0.15	− 159	2078	1.97	1919	1.81	2082	1.97	− 163	−0.15
Sept.	2.49	2.35	2.27	−0.21	− 222	2025	1.92	1803	1.71	2039	1.93	− 236	−0.22
Oct.	2.28	2.21	2.25	−0.08	− 28	2020	1.91	1935	1.83	2021	1.91	− 86	−0.08
Nov.	2.20	2.18	2.32	+0.10	+ 106	2036	1.93	2142	2.03	1994	1.89	+ 148	+0.14
Dec.	2.30	2.42	2.45	+0.29	+ 307	2066	1.95	2373	2.24	1895	1.79	+ 478	+0.45
1907													
Jan.	2.59	2.76	2.96	+0.02	+ 21	2185	2.07	2206	2.09	1779	1.68	+ 427	+0.40
Feb.	2.61	2.46	2.47	−0.26	− 275	2070	1.96	1795	1.70	1711	1.62	+ 84	+0.08
Mar.	2.35	2.24	2.22	+0.13	+ 137	2014	1.90	2151	2.03	1749	1.65	+ 402	+0.38
April	2.48	2.71	2.62	+0.30	+ 317	2105	1.99	2422	2.29	1931	1.83	+ 491	+0.46
May	2.78	2.85	2.84	+0.28	+ 296	2157	2.04	2453	2.32	1962	1.86	+ 491	+0.46
June	3.06	3.27	3.18	+0.23	+ 243	2239	2.12	2482	2.35	1990	1.88	+ 492	+0.47
July	3.29	3.31	3.33	−0.12	− 127	2276	2.15	2149	2.03	2075	1.96	+ 74	+0.07
Aug.	3.17	3.03	3.02	−0.27	− 286	2200	2.08	1914	1.81	2028	1.92	− 114	−0.11
Sept.	2.90	2.77	2.80	−0.17	− 180	2148	2.03	1968	1.86	2047	1.94	− 79	−0.07
Oct.	2.73	2.69	2.79	−0.18	− 190	2145	2.03	1955	1.85	2017	1.91	− 62	−0.06
Nov.	2.55	2.41	2.71	−0.21	− 222	2126	2.01	1904	1.80	1961	1.85	− 57	−0.05
Dec.	2.34	2.26	2.63			2108	1.99			1952	1.85		

a.—Discharge values include a flow of 1,000 c.f.s. through Erie Canal and 1,100 c.f.s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 27.

SUPPLY FACTORS OF LAKE ONTARIO.

DATE	WATER LEVELS OF— LAKE ONTARIO AT OSWEGO, N.Y. First of Month.	Mean of Month.	ST. LAWRENCE RIVER. Ogdensburg, N.Y., Mean of Month.	Lock 27, Head of Galop Canal, Mean of Month.	STORAGE IN LAKE ONTARIO Foot Depth.	100 c.f.s.	OUTFLOW THROUGH ST. LAWRENCE RIVER 100 c.f.s.	Feet Depth, Lake Ontario.	TOTAL SUPPLY TO LAKE ONTARIO 100 c.f.s.	Feet Depth	INFLOW FROM NIAGARA RIVER. *a* 100 c.f.s.	Feet Depth, Lake Ontario	LOCAL SUPPLY TO LAKE ONTARIO 100 c.f.s.	Foot Depth.
1860														
Jan.		246.58	245.65	244.08			2629	3.42			2321	3.02		
Feb.	246.65	6.72	5.78	4.22	+0.09	+ 69	2661	3.46	2730	3.55	2178	2.83	552	0.72
Mar.	6.74	6.77	5.83	4.26	+0.04	+ 31	2689	3.50	2720	3.54	2265	2.95	455	0.59
April	6.78	6.80	5.86	4.29	+0.14	+ 108	2699	3.51	2807	3.65	2423	3.15	384	0.50
May	6.92	7.03	6.07	4.80	+0.38	+ 292	2883	3.75	3175	4 13	2475	3.22	700	0.91
June	7.39	7.57	6.58	5.31	+0.40	+ 307	3062	3.99	3369	4.39	2486	3.24	883	1.15
July	7.70	7.82	6.82	5.55	−0.16	− 123	3146	4.09	3023	3.93	2436	3.17	587	0.76
Aug.	7.54	7.26	6.29	5.02	−0.48	− 369	2960	3.85	2591	3.37	2375	3.09	216	0.28
Sept.	7.06	6.86	5.91	4.64	−0.30	− 231	2827	3.68	2596	3.38	2304	3.00	292	0.38
Oct.	6.76	6.67	5.73	4.46	−0.05	− 38	2767	3.60	2729	3.55	2244	2.92	485	0.63
Nov.	6.71	6.75	5.81	4.54	+0.03	+ 23	2794	3.64	2817	3.67	2248	2.93	569	0.74
Dec.	6.74	6.73	5.79	4.22	−0.16	− 123	2676	3.48	2553	3.32	2256	2.94	297	0.38
1861														
Jan.	6.58	6.44	5.52	3.95	−0.08	− 62	2587	3.37	2525	3.29	2161	2.81	364	0.48
Feb.	6.50	6.56	5.63	4.07	+0.28	+ 215	2615	3.40	2830	3.68	2045	2.66	785	1.02
Mar.	6.78	7.01	6.05	4.49	+0.34	+ 261	2754	3.58	3015	3.92	2136	2.78	879	1.14
April	7.12	7.23	6.26	4.70	+0.58	+ 446	2826	3.68	3272	4.26	2375	3.09	897	1.17
May	7.70	8.18	7.16	5.89	+0.66	+ 507	3267	4.25	3774	4.91	2485	3.23	1289	1.68
June	8.36	8.54	7.50	6.23	+0.07	+ 54	3390	4.41	3444	4.48	2521	3.28	923	1.20
July	8.43	8.32	7.29	6.02	−0.23	− 177	3313	4.31	3136	4.08	2474	3.22	662	0.86
Aug.	8.20	8.07	7.05	5.79	−0.36	− 277	3215	4.18	2938	3.82	2463	3.21	475	0.61
Sept.	7.84	7.60	6.61	5.34	−0.14	− 108	3072	4.00	2964	3.86	2431	3.16	533	0.70
Oct.	7.70	7.81	6.81	5.54	+0.12	+ 92	3141	4.09	3233	4.21	2387	3.11	846	1.10
Nov.	7.82	7.82	6.82	5.55	−0.10	− 77	3147	4.10	3070	4.00	2410	3.14	660	0.86
Dec.	7.72	7.61	6.62	5.06	−0.36	− 277	2949	3.84	2672	3.48	2401	3.12	271	0.36
1862														
Jan.	7.36	7.11	6.15	4.59	−0.46	− 353	2789	3.63	2436	3.17	2365	3.08	71	0.09
Feb.	6.90	6.69	5.75	4.19	+0.04	+ 31	2656	3.46	2687	3.50	2237	2.91	450	0.59
Mar.	6.94	7.18	6.21	4.65	+0.69	+ 530	2808	3.65	3338	4.34	2258	2.94	1080	4.40
April	7.63	8.08	7.06	5.50	+0.85	+ 653	3103	4.04	3756	4.89	2471	3.22	1285	1.67
May	8.48	8.88	7.82	6.55	+0.27	+ 208	3512	4.57	3720	4.84	2531	3.29	1189	1.55
June	8.75	8.62	7.57	6.31	−0.08	− 62	3404	4.43	3342	4.35	2551	3.32	791	1.03
July	8.67	8.72	7.67	6.40	−0.18	− 138	3454	4.50	3316	4.32	2562	3.33	754	0.99
Aug.	8.49	8.26	7.23	5.97	−0.55	− 423	3280	4.27	2857	3.72	2439	3.17	418	0.55
Sept.	7.94	7.61	6.62	5.35	−0.60	− 461	3075	4.00	2614	3.40	2375	3.09	239	0.31
Oct.	7.34	7.08	6.12	4.85	−0.44	− 338	2900	3.77	2562	3.33	2294	2.99	268	0.34
Nov.	6 90	6.73	5.79	4.52	−0.22	− 169	2788	3.63	2619	3.41	2237	2.91	382	0.50
Dec.	6.68	6.62	5.69	4.12	+0.02	+ 15	2642	3.44	2657	3.46	2291	2.98	366	0.48
1863														
Jan.	6.70	6.77	5.83	4.26	+0.10	+ 77	2689	3.50	2766	3.60	2372	3.09	394	0.51
Feb.	6 80	6.83	5.88	4.32	+0.07	+ 54	2698	3.51	2752	3.58	2390	3.11	362	0.47
Mar.	6.87	6.91	5.96	4.40	+0.40	+ 307	2725	3.55	3032	3.95	2361	3.07	671	0.88
April	7.27	7.63	6.64	5.08	+0.56	+ 430	2956	3.85	3386	4.41	2375	3.09	1011	1.32
May	7.83	8.03	7.02	5.75	+0.27	+ 208	3218	4.19	3426	4.46	2418	3.15	1008	1.31
June	8.10	8.18	7.16	5.89	−0.12	− 92	3267	4.25	3175	4.13	2400	3.12	775	1.01
July	7.98	7.77	6.77	5.50	−0.44	− 338	3128	4.07	2790	3.63	2387	3.11	403	0.52
Aug.	7.54	7.31	6.34	5.07	−0.42	− 323	2977	3.87	2654	3.45	2346	3.05	308	0.40
Sept.	7.12	6.93	5.98	4.71	−0.28	− 215	2850	3.71	2635	3.43	2264	2.95	371	0.48
Oct.	6.84	6.74	5.80	4.53	−0.19	− 146	2790	3.63	2644	3.44	2172	2.83	472	0.61
Nov.	6.65	6.56	5.63	4.36	−0.09	− 69	2732	3.56	2663	3.47	2101	2.73	562	0.74
Dec.	6.56	6.57	5.64	4.08	−0.11	− 84	2619	3.41	2535	3.30	2137	2.78	398	0.52
1864														
Jan.	6.45	6.33	5.41	3.85	−0.20	− 154	2544	3.31	2390	3.11	2041	2.66	348	0.45
Feb.	6.25	6.17	5.26	3.70	−0.03	− 23	2496	3.25	2473	3.22	2025	2.64	448	0.58
Mar.	6.22	6.26	5.35	3.78	+0.32	+ 246	2532	3.30	2778	3.62	2061	2.68	717	0.94
April	6.54	6.83	5.88	4.32	+0.78	+ 599	2698	3.51	3297	4.29	2157	2.81	1140	0.48
May	7.32	7.82	6.82	5.55	+0.65	+ 499	3146	4.09	3645	4.74	2332	3.04	1313	1.70
June	7.97	8.12	7.10	5.83	−0.01	− 8	3246	4.22	3238	4.21	2337	3.04	901	1.17
July	7.96	7.80	6.80	5.53	−0.39	− 300	3140	4.09	2840	3.70	2288	2.98	552	0.72
Aug.	7.57	7.34	6.37	5.10	−0.49	− 376	2989	3.89	2613	3.40	2203	2.87	410	0.53
Sept.	7.08	6.81	5.87	4.60	−0.38	− 292	2814	3.66	2522	3.28	2165	2.82	357	0.46
Oct.	6.70	6.58	5.65	4.38	−0.14	− 108	2740	3.57	2632	3.43	2105	2.74	527	0.69
Nov.	6.56	6.55	5.62	4.35	+0.04	+ 31	2730	3.55	2761	3.59	2091	2.72	670	0.87
Dec.	6.60	6.65	5.72	4.15	+0.26	+ 300	2652	3.45	2852	3.71	2153	2.80	699	0.91

a.—Niagara River discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.

NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gage observations taken at Locks 21, 24 and 27, respectively.

TABLE 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

DATE	WATER LEVELS OF— LAKE ONTARIO OSWEGO, N.Y. First of Month.	LAKE ONTARIO OSWEGO, N.Y. Mean of Month.	ST. LAWRENCE RIVER. Ogdensburg, N.Y., Mean of Month.	ST. LAWRENCE RIVER. Lock 27, Head of Galop Canal, Mean of Month.	STORAGE IN LAKE ONTARIO Foot Depth.	STORAGE IN LAKE ONTARIO 100 c.f.s.	OUTFLOW THROUGH ST. LAWRENCE RIVER 100 c.f.s.	OUTFLOW THROUGH ST. LAWRENCE RIVER Feet Depth, Lake Ontario.	TOTAL SUPPLY TO LAKE ONTARIO 100 c.f.s.	TOTAL SUPPLY TO LAKE ONTARIO Feet Depth	INFLOW FROM NIAGARA RIVER. *a* 100 c.f.s.	INFLOW FROM NIAGARA RIVER. *a* Feet Depth, Lake Ontario	LOCAL SUPPLY TO LAKE ONTARIO 100 c.f.s.	LOCAL SUPPLY TO LAKE ONTARIO Foot Depth.
1865														
Jan.	246.86	247.08	246.12	244.56	+0.30	+ 230	2778	3.62	3008	3.92	2022	2.63	986	1.29
Feb.	7.16	7.23	6.26	4.70	+0.14	+ 108	2826	3.68	2934	3.82	1846	2.40	1088	1.42
Mar.	7.30	7.38	6.40	4.84	+0.12	+ 92	2873	3.74	2965	3.86	1904	2.48	1061	1.38
April	7.42	7.46	6.48	4.92	+0.12	+ 92	2900	3.77	2992	3.89	2050	2.67	942	1.22
May	7.54	7.62	6.63	5.36	+0.10	+ 77	3079	4.01	3156	4.11	2183	2.84	973	1.27
June	7.64	7.66	6.67	5.40	−0.06	− 46	3093	4.03	3047	3.97	2195	2.86	852	1.11
July	7.58	7.51	6.53	5.26	−0.38	− 292	3040	3.96	2748	3.58	2203	2.87	545	0.71
Aug.	7.20	6.90	5.95	4.68	−0.60	− 461	2842	3.70	2381	3.10	2165	2.82	216	0.28
Sept.	6.60	6.29	5.38	4.10	−0.42	− 323	2659	3.46	2336	3.04	2171	2.83	165	0.21
Oct.	6.18	6.07	5.17	3.90	−0.24	− 184	2584	3.36	2400	3.12	2112	2.75	288	0.37
Nov.	5.94	5.82	4.93	3.66	−0.20	− 154	2501	3.26	2347	3.06	2050	2.67	267	0.39
Dec.	5.74	5.66	4.78	3.21	−0.18	− 138	2350	3.06	2212	2.88	2061	2.68	151	0.20
1866														
Jan.	5.56	5.46	4.59	3.03	−0.10	− 77	2286	2.98	2209	2.88	1971	2.57	238	0.31
Feb.	5.46	5.47	4.60	3.04	+0.02	+ 15	2288	2.98	2303	3.00	1887	2.46	416	0.54
Mar.	5.48	5.48	4.61	3.04	+0.24	+ 184	2297	2.99	2481	3.23	1962	2.55	519	0.68
April	5.72	5.96	5.06	3.50	+0.27	+ 208	2432	3.17	2640	3.44	2077	2.70	563	0.74
May	5.99	6.02	5.12	3.85	−0.02	− 15	2565	3.34	2550	3.32	2125	2.77	425	0.55
June	5.97	5.92	5.03	3.75	+0.41	+ 315	2543	3.31	2858	3.72	2206	2.87	652	0.85
July	6.38	6.84	5.89	4.62	+0.41	+ 315	2822	3.67	3137	4.08	2248	2.93	889	1.15
Aug.	6.79	6.74	5.80	4.53	−0.09	− 69	2791	3.63	2722	3.54	2169	2.82	553	0.72
Sept.	6.70	6.65	5.72	4.44	−0.12	− 92	2772	3.61	2680	3.49	2169	2.83	511	0.66
Oct.	6.58	6.52	5.59	4.32	−0.18	− 138	2720	3.54	2582	3.36	2181	2.84	401	0.52
Nov.	6.40	6.28	5.37	4.09	−0.16	− 123	2655	3.46	2532	3.30	2150	2.80	382	0.50
Dec.	6.24	6.20	5.29	3.73	−0.16	− 123	2505	3.26	2382	3.10	2197	2.86	185	0.24
1867														
Jan.	6.08	5.95	5.06	3.49	−0.14	− 108	2438	3.17	2330	3.03	2098	2.73	232	0.30
Feb.	5.94	5.92	5.03	3.46	+0.33	+ 254	2428	3.16	2682	3.49	1975	2.57	707	0.92
Mar.	6.27	6.62	5.69	4.12	+0.80	+ 615	2642	3.44	3257	4.24	2055	2.67	1202	1.57
April	7.07	7.52	6.54	4.97	+0.79	+ 607	2929	3.81	3536	4.60	2112	2.75	1424	1.85
May	7.86	8.21	7.19	5.92	+0.48	+ 369	3278	4.27	3647	4.75	2234	2.91	1413	1.84
June	8.34	8.48	7.44	6.17	−0.04	− 31	3370	4.39	3339	4.35	2330	3.03	1009	1.32
July	8.30	8.11	7.09	5.82	−0.50	− 384	3243	4.22	2859	3.72	2298	2.99	561	0.73
Aug.	7.80	7.48	6.50	5.23	−0.57	− 438	3030	3.94	2592	3.37	2203	2.87	389	0.50
Sept.	7.23	6.98	6.03	4.76	−0.57	− 438	2866	3.73	2428	3.16	2123	2.76	305	0.40
Oct.	6.66	6.33	5.41	4.14	−0.70	− 538	2659	3.46	2121	2.76	2058	2.68	63	0.08
Nov.	5.96	5.59	4.72	3.44	−0.75	− 576	2445	3.18	1869	2.43	1970	2.56	−101	−0.13
Dec.	5.21	4.83	4.00	2.43	−0.54	− 415	2111	2.75	1696	2.21	1964	2.56	−268	−0.35
1868														
Jan.	4.67	4.51	3.70	2.93	−0.11	− 84	1699	2.21	1615	2.10	1891	2.46	−276	−0.36
Feb.	4.56	4.61	3.79	2.22	+0.18	+ 138	2049	2.67	2187	2.85	1765	2.30	422	0.55
Mar.	4.74	4.88	4.05	2.48	+0.46	+ 353	2126	2.77	2479	3.23	1878	2.44	601	0.79
April	5.20	5.52	4.65	3.08	+0.62	+ 476	2309	3.01	2785	3.63	2048	2.67	737	0.96
May	5.82	6.12	5.22	3.94	+0.51	+ 392	2605	3.39	2997	3.90	2149	2.80	848	1.10
June	6.33	6.54	5.61	4.34	+0.15	+ 115	2725	3.55	2840	3.70	2261	2.94	579	0.76
July	6.48	6.42	5.50	4.22	−0.20	− 154	2699	3.51	2545	3.31	2270	2.95	275	0.36
Aug.	6.28	6.13	5.23	3.95	−0.24	− 184	2609	3.40	2425	3.16	2125	2.77	300	0.39
Sept.	6.04	5.94	5.05	3.77	−0.40	− 307	2552	3.32	2245	2.92	2077	2.70	168	0.22
Oct.	5.64	5.35	4.49	3.21	−0.36	− 277	2370	3.08	2093	2.72	1987	2.59	106	0.13
Nov.	5.28	5.20	4.35	3.07	0.00	0	2326	3.03	2326	3.03	1976	2.57	350	0.46
Dec.	5.28	5.37	4.51	2.94	+0.02	+ 15	2266	2.95	2281	2.97	1973	2.57	308	0.40
1869														
Jan.	5.30	5.22	4.37	2.80	−0.02	− 15	2223	2.89	2208	2.87	1941	2.53	267	0.34
Feb.	5.28	5.34	4.48	2.91	+0.17	+ 131	2257	2.94	2388	3.11	1878	2.44	510	0.67
Mar.	5.45	5.56	4.69	3.12	+0.37	+ 284	2322	3.02	2606	3.39	1973	2.57	633	0.82
April	5.82	6.09	5.19	3.62	+0.60	+ 461	2480	3.23	2941	3.83	2025	2.64	916	1.19
May	6.42	6.75	5.81	4.54	+0.44	+ 338	2794	3.64	3132	4.08	2149	2.80	983	1.28
June	6.86	6.97	6.18	4.75	+0.27	+ 208	3076	4.00	3284	4.27	2261	2.94	1023	1.33
July	7.13	7.29	6.41	5.05	+0.19	+ 146	3091	4.02	3237	4.21	2348	3.06	889	1.15
Aug.	7.32	7.35	6.41	5.11	−0.06	− 46	3029	3.94	2983	3.88	2304	3.00	679	0.88
Sept.	7.27	7.17	6.16	4.94	−0.14	− 108	2862	3.72	2754	3.58	2251	2.93	503	0.65
Oct.	7.12	7.08	6.08	4.85	−0.24	− 184	2845	3.70	2661	3.46	2157	2.81	504	0.65
Nov.	6.88	6.68	5.70	4.47	−0.12	− 92	2717	3.54	2625	3.42	2075	2.70	550	0.72
Dec.	6.76	6.85	6.04	4.34	+0.30	+ 230	2852	3.71	3082	4.01	2203	2.87	879	1.14

a.—Niagara River discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.

NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gage observations taken at Locks 21, 24 and 27, respectively.

SESSIONAL PAPER No. 54.

TABLE 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

DATE	WATER LEVELS OF— LAKE ONTARIO OSWEGO, N.Y. First of Month.	Mean of Month.	ST. LAWRENCE RIVER. Ogdensburg, N.Y., Mean of Month.	Lock 27, Head of Galop Canal, Mean of Month.	STORAGE IN LAKE ONTARIO Foot Depth.	100 c.f.s.	OUTFLOW THROUGH ST. LAWRENCE RIVER 100 c.f.s.	Feet Depth, Lake Ontario.	TOTAL SUPPLY TO LAKE ONTARIO 100 c.f.s.	Feet Depth	INFLOW FROM NIAGARA RIVER. *a* 100 c.f.s.	Feet Depth, Lake Ontario	LOCAL SUPPLY TO LAKE ONTARIO 100 c.f.s.	Foot Depth.
1870														
Jan.	247.06	247.26	246.32	244.73	+0.28	+ 215	2748	3.58	2963	3.86	2229	2.90	734	0.99
Feb.	7.34	7.41	6.36	4.87	+0.07	+ 54	[21]2040	2.66	2094	2.73	2231	2.90	−137	−0.18
Mar.	7.41	7.41	6.16	4.87	+0.47	+ 361	[21]2760	3.59	3121	4.06	2164	2.82	957	1.25
April	7.88	8.35	7.35	5.76	+0.77	+ 592	3232	4.21	3824	4.98	2306	3.00	1518	1.98
May	8.65	8.95	7.87	6.62	+0.14	+ 108	3505	4.56	3613	4.70	2356	3.07	1257	1.63
June	8.79	8.63	7.60	6.32	−0.32	− 246	3441	4.48	3195	4.16	2368	3.08	827	1.08
July	8.47	8.31	7.36	6.01	−0.33	− 254	3432	4.47	3178	4.14	2395	3.12	783	1.02
Aug.	8.14	7.97	7.03	5.69	−0.52	− 400	3298	4.29	2898	3.77	2361	3.07	537	0.70
Sept.	7.62	7.28	6.19	5.04	−0.50	− 384	2795	3.64	2411	3.14	2314	3.01	97	0.13
Oct.	7.12	6.95	5.87	4.73	−0.46	− 353	2681	3.49	2328	3.03	2234	2.91	94	0.12
Nov.	6.66	6.38	5.64	4.19	−0.40	− 307	2898	3.77	2591	3.37	2188	2.85	403	0.52
Dec.	6.26	6.13	5.23	3.66	−0.16	− 123	2493	3.24	2370	3.08	2206	2.87	164	0.21
1871														
Jan.	6.10	6.06	5.16	3.59	−0.12	− 92	2471	3.22	2379	3.10	2123	2.76	256	0.34
Feb.	5.98	5.89	5.00	3.43	+0.02	+ 15	2419	3.15	2434	3.17	1997	2.60	437	0.57
Mar.	6.00	6.10	5.20	3.63	+0.40	+ 307	2483	3.23	2790	3.63	2088	2.72	702	0.91
April	6.40	6.70	5.76	4.20	+0.51	+ 392	2658	3.46	3050	3.97	2185	2.84	865	1.13
May	6.91	7.12	6.02	4.89	+0.18	+ 138	2722	3.54	2860	3.72	2248	2.93	612	0.80
June	7.09	7.06	6.28	4.83	−0.11	− 84	3131	4.08	3047	3.97	2273	2.96	774	1.01
July	6.98	6.90	6.01	4.68	−0.30	− 230	2921	3.80	2691	3.50	2285	2.97	406	0.53
Aug.	6.68	6.46	5.66	4.26	−0.39	− 300	2857	3.72	2557	3.33	2215	2.88	342	0.45
Sept.	6.29	6.12	5.34	3.94	−0.42	− 323	2749	3.58	2426	3.16	2188	2.85	238	0.31
Oct.	5.87	5.62	4.99	3.47	−0.45	− 346	2722	3.54	2376	3.09	2045	2.66	331	0.43
Nov.	5.42	5.21	4.39	3.08	−0.36	− 277	2361	3.07	2084	2.71	2029	2.64	55	0.07
Dec.	5.06	4.90	4.07	2.50	−0.24	− 184	2132	2.77	1948	2.53	1973	2.57	− 25	−0.04
1872														
Jan.	4.82	4.73	3.91	2.34	−0.20	− 154	[21]2062	2.68	1908	2.48	1925	2.51	− 17	−0.02
Feb.	4.62	4.51	3.70	2.13	−0.19	− 146	[21]1873	2.44	1727	2.25	1828	2.38	−101	−0.13
Mar.	4.43	4.35	3.55	1.98	+0.17	+ 131	[21]1945	2.53	2076	2.70	1798	2.34	278	0.36
April	4.60	4.84	4.01	2.44	+0.30	+ 230	2114	2.75	2344	3.05	1825	2.38	519	0.67
May	4.90	4.96	3.41	2.85	+0.22	+ 169	2448	3.19	2617	3.41	1917	2.50	700	0.91
June	5.12	5.29	4.53	3.16	+0.20	+ 154	2453	3.19	2607	3.39	2016	2.62	591	0.77
July	5.32	5.35	4.77	3.21	−0.05	− 38	2675	3.48	2637	3.43	2029	2.64	608	0.79
Aug.	5.27	5.19	4.66	3.06	−0.23	− 177	2665	3.47	2488	3.24	2005	2.61	483	0.63
Sept.	5.04	4.90	4.59	2.79	−0.22	− 169	2768	3.60	2599	3.38	1966	2.56	633	0.82
Oct.	4.82	4.74	4.09	2.64	−0.10	− 77	2366	3.08	2289	2.98	1941	2.53	348	0.45
Nov.	4.72	4.69	3.87	2.59	−0.20	− 154	2177	2.83	2023	2.63	1893	2.46	130	0.17
Dec.	4.52	4.35	3.55	1.98	−0.19	− 146	1978	2.57	1832	2.38	1885	2.45	− 53	−0.07
1873														
Jan.	4.33	4.31	3.51	1.94	+0.01	+ 8	1967	2.56	1975	2.57	1835	2.39	140	0.18
Feb.	4.34	4.38	3.58	2.00	+0.10	+ 77	1992	2.59	2069	2.69	1792	2.33	277	0.36
Mar.	4.44	4.50	3.69	2.12	+1.04	+ 799	2019	2.63	2818	3.67	1796	2.34	1022	1.33
April	5.48	6.46	5.54	3.97	+1.25	+ 960	2592	3.37	3552	4.62	2061	2.68	1491	1.94
May	6.73	7.00	6.15	4.77	+0.23	+ 177	3016	3.93	3193	4.16	2217	2.89	976	1.27
June	6.96	6.92	6.18	4.70	−0.06	− 46	3121	4.06	3075	4.00	2255	2.93	820	1.07
July	6.90	6.88	6.20	4.66	−0.16	− 123	3183	4.14	3060	3.98	2267	2.95	793	1.03
Aug.	6.74	6.60	5.67	4.40	−0.35	− 269	2746	3.57	2477	3.22	2231	2.90	246	0.32
Sept.	6.39	6.18	5.27	4.00	−0.43	− 330	2613	3.40	2283	2.97	2150	2.80	133	0.17
Oct.	5.96	5.73	4.85	3.57	−0.30	− 230	2486	3.24	2256	2.94	2094	2.73	162	0.21
Nov.	5.66	5.60	4.73	3.45	+0.04	+ 31	2447	3.18	2478	3.22	2072	2.70	406	0.52
Dec.	5.70	5.79	4.90	3.34	+0.37	+ 284	2381	3.10	2665	3.47	2206	2.87	459	0.60
1874														
Jan.	6.07	6.35	5.43	3.87	+0.48	+ 369	2551	3.32	2920	3.80	2269	2.95	651	0.85
Feb.	6.55	6.75	5.81	4.24	+0.47	+ 361	[21]2632	3.43	2993	3.90	2227	2.90	766	1.00
Mar.	7.02	7.30	6.33	4.77	+0.22	+ 169	2849	3.71	3018	3.93	2221	2.89	797	1.04
April	7.24	7.19	6.22	4.66	−0.06	− 46	2812	3.66	2766	3.60	2246	2.92	520	0.68
May	7.18	7.17	6.21	4.94	+0.04	+ 31	2933	3.82	2964	3.86	2267	2.95	697	0.91
June	7.22	7.26	6.29	5.02	+0.02	+ 15	2960	3.85	2975	3.87	2301	2.99	674	0.88
July	7.24	7.21	6.24	4.97	−0.14	− 108	2945	3.83	2837	3.69	2327	3.03	510	0.66
Aug.	7.10	6.98	6.16	4.76	−0.44	− 338	3039	3.96	2701	3.52	2267	2.95	434	0.57
Sept.	6.66	6.34	5.42	4.15	−0.52	− 400	2662	3.46	2262	2.94	2170	2.82	92	0.12
Oct.	6.14	5.94	5.05	3.77	−0.48	− 369	2551	3.32	2182	2.84	2079	2.71	103	0.13
Nov.	5.66	5.37	4.51	3.23	−0.46	− 353	2377	3.09	2024	2.63	2009	2.61	15	0.02
Dec.	5.20	5.03	4.19	2.62	−0.32	− 246	2168	2.82	1922	2.50	2005	2.61	− 83	−0.11

a.—Niagara River discharge values indicate a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.

NOTE.—21, 24 and 27 indicate that St. Lawrence River discharge were derived from gage observations taken at Locks 21, 24 and 27, respectively.

TABLE 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

DATE	WATER LEVELS OF—				STORAGE IN LAKE ONTARIO		OUTFLOW THROUGH ST. LAWRENCE RIVER		TOTAL SUPPLY TO LAKE ONTARIO		INFLOW FROM NIAGARA RIVER. *a*		LOCAL SUPPLY TO LAKE ONTARIO	
	LAKE ONTARIO AT OSWEGO, N.Y.		ST. LAWRENCE RIVER.											
	First of Month.	Mean of Month.	Ogdensburg, N.Y., Mean of Month.	Lock 27, Head of Galop Canal, Mean of Month.	Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Feet Depth	100 c.f.s.	Feet Depth, Lake Ontario	100 c.f.s.	Foot Depth.
1875														
Jan.	244.88	244.73	243.91	241.45	−0.32	− 246	[27]1843	2.40	1597	2.08	1923	2.50	−326	−0.42
Feb.	4.56	4.38	3.58	0.46	−0.05	− 38	[27]1579	2.06	1541	2.01	1840	2.39	−299	−0.39
Mar.	4.51	4.64	3.82	1.77	+0.53	+ 407	[27]1931	2.51	2338	3.04	1860	2.42	478	0.62
April	5.04	5.44	4.57	3.24	+0.54	+ 415	2435	3.17	2850	3.71	1929	2.51	921	1.20
May	5.58	5.71	4.83	3.61	+0.21	+ 161	2428	3.16	2589	3.37	2033	2.65	556	0.72
June	5.79	5.87	4.98	3.80	+0.09	+ 69	2440	3.18	2509	3.27	2149	2.80	360	0.47
July	5.88	5.90	5.01	3.79	−0.05	− 38	2484	3.23	2446	3.18	2197	2.86	249	0.32
Aug.	5.83	5.76	4.88	3.62	−0.17	− 131	2478	3.23	2347	3.06	2176	2.83	171	0.23
Sept.	5.66	5.55	4.68	3.53	−0.25	− 192	2320	3.02	2128	2.77	2157	2.81	− 29	−0.04
Oct.	5.41	5.27	4.41	3.15	−0.23	− 177	2329	3.03	2152	2.80	2056	2.68	96	0.12
Nov.	5.18	5.08	4.24	2.81	−0.19	− 146	2402	3.13	2256	2.94	2047	2.66	209	0.28
Dec.	4.99	4.90	4.07	2.77	+0.11	+ 84	2253	2.93	2337	3.04	2143	2.79	194	0.25
1876														
Jan.	5.10	5.31	4.45	2.91	+0.54	+ 415	2229	2.90	2644	3.44	2102	2.74	542	0.70
Feb.	5.64	5.97	5.07	3.73	+0.60	+ 461	[21]2478	3.23	2939	3.83	2183	2.84	756	0.98
Mar.	6.24	6.52	5.59	4.02	+0.77	+ 592	[21]2583	3.36	3175	4.13	2332	3.04	843	1.10
April	7.01	7.50	6.52	5.35	+0.78	+ 599	2931	3.81	3530	4.59	2446	3.18	1084	1.41
May	7.79	8.08	7.06	5.95	+0.40	+ 307	3041	3.96	3348	4.36	2528	3.29	820	1.07
June	8.19	8.30	7.27	6.23	+0.15	+ 115	3023	3.93	3138	4.08	2578	3.36	560	0.72
July	8.34	8.37	7.34	6.25	−0.20	− 154	3112	4.05	2958	3.85	2567	3.34	391	0.51
Aug.	8.14	7.91	6.90	5.64	−0.54	− 415	3164	4.12	2749	3.58	2465	3.21	284	0.37
Sept.	7.60	7.30	6.33	4.99	−0.47	− 361	3042	3.96	2681	3.49	2435	3.17	246	0.32
Oct.	7.13	6.96	6.01	4.92	−0.35	− 269	2672	3.48	2403	3.13	2317	3.02	86	0.11
Nov.	6.78	6.60	5.67	4.20	−0.27	− 208	2926	3.81	2718	3.54	2365	3.08	353	0.46
Dec.	6.51	6.42	5.50	3.67	−0.35	− 269	2748	3.58	2479	3.23	2327	3.03	152	0.20
1877														
Jan.	6.16	5.89	5.00	2.37	−0.40	− 307	[27]2100	2.73	1793	2.33	2196	2.86	−403	−0.52
Feb.	5.76	5.62	4.74	3.17	−0.06	− 46	2337	3.04	2291	2.98	2105	2.74	186	0.24
Mar.	5.70	5.77	4.89	3.57	+0.42	+ 323	[27]2452	3.19	2775	3.61	2041	2.66	724	0.96
April	6.12	6.46	5.54	3.80	+0.38	+ 292	2706	3.52	2998	3.90	2124	2.76	874	1.14
May	6.50	6.53	5.60	4.51	−0.02	− 15	2546	3.31	2531	3.29	2181	2.84	350	0.45
June	6.48	6.43	5.51	4.38	−0.03	− 23	2560	3.33	2537	3.30	2217	2.89	320	0.41
July	6.45	6.47	5.55	4.56	−0.11	− 84	2424	3.15	2340	3.04	2294	2.99	46	0.05
Aug.	6.34	6.20	5.29	4.05	−0.36	− 277	2594	3.38	2317	3.02	2239	2.91	78	0.11
Sept.	5.98	5.77	4.89	3.51	−0.42	− 323	2580	3.36	2257	2.94	2234	2.91	23	0.03
Oct.	5.56	5.34	4.48	2.90	−0.26	− 200	2586	3.37	2386	3.11	2152	2.80	234	0.31
Nov.	5.30	5.25	4.10	3.00	+0.02	+ 15	2433	3.17	2448	3.19	2159	2.81	289	0.38
Dec.	5.32	5.38	4.52	2.99	+0.11	+ 84	2245	2.92	2329	3.03	2225	2.90	104	0.13
1878														
Jan.	5.43	5.48	4.61	2.97	+0.15	+ 115	[27]2273	2.96	2388	3.11	2213	2.88	175	0.23
Feb.	5.58	5.69	4.81	3.20	+0.46	+ 353	[27]2342	3.05	2695	3.51	2195	2.86	500	0.65
Mar.	6.04	6.39	5.47	4.01	+0.48	+ 369	2493	3.24	2862	3.72	2213	2.88	649	0.84
April	6.52	6.64	5.71	4.63	+0.29	+ 223	2570	3.34	2793	3.63	2298	2.99	495	0.64
May	6.81	6.98	6.03	5.20	+0.17	+ 131	2370	3.08	2501	3.25	2356	3.07	145	0.18
June	6.98	6.97	6.02	4.74	−0.03	− 23	2875	3.74	2852	3.71	2375	3.09	477	0.62
July	6.95	6.93	5.98	4.63	−0.06	− 46	2930	3.81	2884	3.75	2393	3.11	491	0.64
Aug.	6.89	6.85	5.90	4.53	−0.17	− 131	2920	3.80	2789	3.63	2317	3.02	472	0.61
Sept.	6.72	6.59	5.66	4.31	−0.26	− 200	2816	3.66	2616	3.40	2298	2.99	318	0.41
Oct.	6.46	6.33	5.41	3.99	−0.19	− 146	2792	3.63	2646	3.44	2227	2.90	419	0.54
Nov.	6.27	6.21	5.30	3.84	+0.35	+ 269	2786	3.63	3055	3.98	2206	2.87	849	1.11
Dec.	6.62	7.02	6.06	4.95	+0.30	+ 230	2711	3.53	2941	3.83	2271	2.96	670	0.87
1879														
Jan.	6.92	6.81	5.87	3.39	−0.29	− 223	[27]2398	3.12	2175	2.83	2137	2.78	38	0.05
Feb.	6.63	6.45	5.53	3.75	−0.25	− 192	[21]2378	3.10	2186	2.85	2055	2.67	131	0.17
Mar.	6.38	6.30	5.39	3.81	+0.12	+ 92	[21]2381	3.10	2473	3.22	2051	2.67	422	0.55
April	6.50	6.71	5.77	4.36	+0.26	+ 200	2550	3.32	2750	3.58	2118	2.76	632	0.82
May	6.76	6.80	5.86	4.44	+0.06	+ 46	2950	3.84	2996	3.90	2149	2.80	847	1.10
June	6.82	6.83	5.88	4.54	−0.07	− 54	2882	3.75	2828	3.68	2187	2.85	641	0.83
July	6.75	6.67	5.73	4.50	−0.25	− 192	2727	3.55	2535	3.30	2213	2.88	322	0.42
Aug.	6.50	6.32	5.40	3.86	−0.39	− 300	2884	3.75	2584	3.36	2140	2.79	444	0.57
Sept.	6.11	5.90	5.01	3.45	−0.43	− 330	2759	3.59	2429	3.16	2077	2.70	352	0.46
Oct.	5.68	5.46	4.59	2.86	−0.42	− 323	2724	3.55	2401	3.13	2038	2.65	363	0.48
Nov.	5.26	5.07	4.23	2.94	−0.18	− 138	2297	2.99	2159	2.81	1956	2.55	203	0.26
Dec.	5.08	5.10	4.25	2.90	+0.13	+ 100	2346	3.05	2446	3.18	2059	2.68	387	0.50

a.—Niagara River discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.

NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gage observations taken at Locks 21 24, and 27, respectively.

TABLE 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

DATE	WATER LEVELS OF—				STORAGE IN LAKE ONTARIO		OUTFLOW THROUGH ST. LAWRENCE RIVER		TOTAL SUPPLY TO LAKE ONTARIO		INFLOW FROM NIAGARA RIVER, *a*		LOCAL SUPPLY TO LAKE ONTARIO	
	LAKE ONTARIO		ST. LAWRENCE RIVER.											
	OSWEGO, N.Y.		Ogdensburg, N.Y., Mean of Month.	Lock 27, Head of Galop Canal, Mean of Month.	Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Feet Depth	100 c.f.s.	Feet Depth, Lake Ontario	100 c.f.s.	Foot Depth.
	First of Month.	Mean of Month.												
1880														
Jan.	245.21	245.32	244.46	243.03	+0.25	+ 192	2165	2.82	2357	3.07	2146	2.79	211	0.28
Feb.	5.46	5.60	4.73	3.48	+0.31	+ 238	2424	3.15	2662	3.46	2103	2.74	559	0.73
Mar.	5.77	5.94	5.05	3.60	+0.26	+ 200	2355	3.07	2555	3.33	2124	2.76	431	0.57
April	6.03	6.12	5.22	4.04	+0.17	+ 131	2513	3.27	2644	3.44	2145	2.79	499	0.65
May	6.20	6.27	5.36	4.14	+0.19	+ 146	2599	3.38	2745	3.57	2207	2.87	538	0.70
June	6.39	6.51	5.58	4.33	+0.13	+ 100	2696	3.51	2796	3.64	2251	2.93	545	0.71
July	6.52	6.52	5.59	4.33	−0.22	− 169	2710	3.53	2541	3.31	2291	2.98	250	0.33
Aug.	6.30	6.09	5.19	3.91	−0.40	− 307	2597	3.38	2290	2.98	2213	2.88	77	0.10
Sept.	5.90	5.72	4.84	3.60	−0.38	− 292	2449	3.19	2157	2.81	2172	2.83	− 15	−0.02
Oct.	5.52	5.31	4.45	3.27	−0.23	− 177	2276	2.96	2099	2.73	2081	2.71	18	0.02
Nov.	5.29	5.27	4.41	3.29	−0.11	− 84	2212	2.88	2128	2.77	2088	2.72	40	0.05
Dec.	5.18	5.10	4.25	2.74	−0.26	− 200	2152	2.80	1952	2.54	2055	2.67	−103	−0.13
1881														
Jan.	4.92	4.74	3.91	1.02	−0.18	− 138	[27]1726	2.25	1588	2.07	1931	2.51	−343	−0.45
Feb.	4.74	4.73	3.91	1.56	+0.32	+ 246	[21]1723	2.24	1969	2.56	1908	2.48	61	0.08
Mar.	5.06	5.39	4.53	2.83	+0.54	+ 415	[21]2230	2.90	2645	3.44	1968	2.56	677	0.88
April	5.60	5.81	4.92	3.53	+0.30	+ 230	2598	3.38	2828	3.68	2112	2.75	716	0.93
May	5.90	5.99	5.09	3.72	+0.20	+ 154	2641	3.44	2795	3.64	2205	2.87	590	0.77
June	6.10	6.21	5.30	3.93	+0.14	+ 108	2710	3.53	2818	3.67	2281	2.97	527	0.70
July	6.24	6.28	5.37	4.04	−0.12	− 92	2699	3.51	2607	3.39	2286	2.98	321	0.41
Aug.	6.12	5.96	5.06	3.72	−0.44	− 338	2605	3.39	2267	2.95	2188	2.85	79	0.10
Sept.	5.68	5.40	4.54	3.39	−0.39	− 300	2278	2.96	1978	2.57	2119	2.76	−141	−0.19
Oct.	5.29	5.18	4.33	3.02	−0.11	− 84	2343	3.05	2259	2.94	2121	2.76	138	0.18
Nov.	5.18	5.18	4.33	3.06	0.00	0	2313	3.01	2313	3.01	2105	2.74	208	0.27
Dec.	5.18	5.18	4.33	3.10	+0.28	+ 215	2281	2.97	2496	3.25	2200	2.86	296	0.39
1882														
Jan.	5.46	5.73	4.85	3.20	+0.36	+ 277	[27]2342	3.05	2619	3.41	2283	2.97	336	0.44
Feb.	5.82	5.90	5.01	3.44	+0.38	+ 292	[21]2387	3.11	2679	3.49	2229	2.90	450	0.59
Mar.	6.20	6.50	5.57	4.07	+0.46	+ 353	2553	3.32	2906	3.78	2330	3.03	576	0.75
April	6.66	6.83	5.88	4.84	+0.26	+ 200	2579	3.36	2779	3.62	2367	3.08	412	0.54
May	6.92	7.02	6.06	4.69	+0.36	+ 277	2975	3.87	3252	4.23	2416	3.14	836	1.09
June	7.28	7.53	6.54	5.40	+0.24	+ 184	2901	3.78	3085	4.02	2474	3.22	611	0.80
July	7.52	7.52	6.54	5.34	−0.16	− 123	2970	3.87	2847	3.71	2474	3.22	373	0.49
Aug.	7.36	7.19	6.22	4.95	−0.36	− 277	2937	3.82	2660	3.46	2416	3.14	244	0.32
Sept.	7.00	6.81	5.87	4.46	−0.44	− 338	2946	3.83	2608	3.39	2362	3.07	246	0.32
Oct.	6.56	6.30	5.39	4.10	−0.47	− 361	2670	3.47	2309	3.00	2265	2.95	44	0.05
Nov.	6.09	5.88	4.99	3.67	−0.35	− 269	2566	3.34	2297	2.99	2213	2.88	84	0.11
Dec.	5.74	5.59	4.72	3.51	−0.28	− 215	2385	3.10	2170	2.82	2135	2.78	35	0.04
1883														
Jan.	5.46	5.32	4.46	1.87	−0.11	− 84	[27]1959	2.55	1875	2.44	2084	2.71	−209	−0.27
Feb.	5.35	5.38	4.52	2.01	+0.15	+ 115	[24]1872	2.44	1987	2.59	2081	2.71	− 94	−0.12
Mar.	5.50	5.62	4.74	2.76	+0.38	+ 292	[24]2213	2.88	2505	3.26	2115	2.75	390	0.51
April	5.88	6.14	5.23	3.78	+0.58	+ 446	2411	3.14	2857	3.72	2126	2.77	731	0.95
May	6.46	6.79	5.85	4.56	+0.68	+ 522	2827	3.68	3349	4.36	2234	2.91	1115	1.45
June	7.14	7.49	6.51	5.37	+0.62	+ 476	2892	3.76	3368	4.38	2427	3.16	941	1.22
July	7.76	8.02	7.01	5.77	+0.17	+ 131	3180	4.14	3311	4.31	2500	3.25	811	1.06
Aug.	7.93	7.84	6.84	5.58	−0.33	− 254	3141	4.09	2887	3.76	2462	3.20	425	0.56
Sept.	7.60	7.36	6.38	5.10	−0.46	− 353	3001	3.91	2648	3.45	2397	3.12	251	0.33
Oct.	7.14	6.92	5.97	4.66	−0.34	− 261	2886	3.76	2625	3.42	2332	3.04	293	0.38
Nov.	6.80	6.69	5.75	4.59	−0.18	− 138	2664	3.47	2526	3.29	2265	2.95	261	0.34
Dec.	6.62	6.55	5.62	4.42	−0.09	− 69	2662	3.46	2593	3.37	2320	3.02	273	0.35
1884														
Jan.	6.53	6.51	5.58	3.29	+0.17	+ 131	[24]2184	2.84	2315	3.01	2206	2.87	109	0.14
Feb.	6.70	6.88	5.93	3.76	+0.52	+ 400	[24]2324	3.02	2724	3.55	2215	2.88	509	0.66
Mar.	7.22	7.56	6.57	4.46	+0.64	+ 492	[27]2724	3.55	3216	4.19	2248	2.93	968	1.26
April	7.86	8.17	7.15	5.71	+0.32	+ 246	3029	3.94	3275	4.26	2370	3.08	905	1.18
May	8.18	8.19	7.17	5.92	−0.04	− 31	3248	4.23	3217	4.19	2436	3.17	781	1.02
June	8.14	8.09	7.07	5.81	−0.16	− 123	3224	4.20	3101	4.04	2475	3.22	626	0.81
July	7.98	7.88	6.87	5.61	−0.22	− 169	3153	4.10	2984	3.88	2436	3.17	548	0.71
Aug.	7.76	7.65	6.66	5.52	−0.32	− 246	2944	3.83	2698	3.51	2375	3.09	323	0.42
Sept.	7.44	7.22	6.39	5.15	−0.43	− 330	2963	3.86	2633	3.43	2281	2.97	352	0.46
Oct.	7.01	6.80	5.97	4.67	−0.46	− 353	2876	3.74	2523	3.28	2215	2.88	308	0.40
Nov.	6.55	6.30	5.55	4.33	−0.33	− 254	2657	3.46	2403	3.13	2126	2.77	277	0.36
Dec.	6.22	6.15	5.24	4.13	−0.08	− 62	2454	3.19	2392	3.11	2155	2.80	237	0.31

a.—Niagara River discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.

NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gage observations taken at Locks 21, 24 and 27 respectively.

TABLE 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

DATE	WATER LEVELS OF—				STORAGE IN LAKE ONTARIO		OUTFLOW THROUGH ST. LAWRENCE RIVER		TOTAL SUPPLY TO LAKE ONTARIO		INFLOW FROM NIAGARA RIVER. *a*		LOCAL SUPPLY TO LAKE ONTARIO	
	LAKE ONTARIO AT OSWEGO, N.Y.		ST. LAWRENCE RIVER.											
	First of Month.	Mean of Month.	Ogdensburg, N.Y., Mean of Month.	Lock 27, Head of Galop Canal, Mean of Month.	Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Feet Depth	100 c.f.s.	Feet Depth, Lake ntario	100 c.f.s.	Foot Depth.
1885														
Jan.	246.14	246.14	245.23	243.73	−0.14	−108	[24]2270	2.95	2162	2.81	2081	2.71	81	0.11
Feb.	6.00	5.87	4.98	2.52	−0.27	−208	[24]2121	2.76	1913	2.49	1984	2.58	− 71	−0.09
Mar.	5.73	5.59	4.72	2.73	+0.20	+154	[24]2197	2.86	2351	3.06	1941	2.53	410	0.53
April	5.93	6.27	5.36	3.69	+0.74	+569	2600	3.38	3169	4.12	2112	2.75	1057	1.37
May	6.67	7.07	6.11	4.96	+0.59	+453	2771	3.61	3224	4.20	2286	2.98	938	1.22
June	7.26	7.44	6.47	5.35	+0.25	+192	2855	3.72	3047	3.97	2434	3.17	613	0.80
July	7.51	7.58	6.59	5.45	−0.01	− 8	2920	3.80	2912	3.79	2441	3.18	471	0.61
Aug.	7.50	7.43	6.45	5.30	−0.18	−138	2884	3.75	2746	3.57	2423	3.15	323	0.42
Sept.	7.32	7.21	6.24	5.11	−0.20	−154	2792	3.63	2638	3.43	2400	3.12	238	0.31
Oct.	7.12	7.02	6.05	4.87	−0.08	− 62	2784	3.62	2722	3.54	2390	3.11	332	0.43
Nov.	7.04	7.07	6.11	4.86	+0.12	+ 92	2877	3.74	2969	3.86	2387	3.11	582	0.75
Dec.	7.16	7.24	6.27	5.07	+0.26	+200	2879	3.75	3079	4.01	2423	3.15	656	0.86
1886														
Jan.	7.42	7.60	6.61	5.15	+0.22	+169	[24]2787	3.63	2956	3.85	2395	3.12	561	0.73
Feb.	7.64	7.67	6.68	5.06	+0.10	+ 77	[21]2397	3.12	2474	3.22	2159	2.81	315	0.41
Mar.	7.74	7.81	6.81	5.02	+0.38	+292	[21]2693	3.51	2985	3.88	2103	2.74	882	1.15
April	8.12	8.43	7.39	5.90	+0.42	+323	3159	4.11	3482	4.53	2298	2.99	1184	1.54
May	8.54	8.64	7.59	6.49	0.00	0	3208	4.18	3208	4.18	2372	3.09	836	1.09
June	8.54	8.44	7.40	6.28	−0.30	−230	3172	4.13	2942	3.83	2416	3.14	526	0.69
July	8.24	8.04	7.03	5.83	−0.42	−323	3140	4.09	2817	3.67	2428	3.16	389	0.51
Aug.	7.82	7.60	6.61	5.47	−0.40	−307	2928	3.81	2621	3.41	2357	3.07	264	0.34
Sept.	7.42	7.24	6.27	5.16	−0.32	−246	2780	3.62	2534	3.30	2307	3.00	227	0.30
Oct.	7.10	6.95	6.00	4.76	−0.37	−284	2829	3.68	2545	3.31	2267	2.95	278	0.36
Nov.	6.73	6.51	5.58	4.62	−0.27	−208	2399	3.12	2191	2.85	2222	2.89	− 31	−0.04
Dec.	6.46	6.42	5.50	4.31	−0.16	−123	2614	3.40	2491	3.24	2246	2.92	245	0.32
1887														
Jan.	6.30	6.17	5.26	3.97	+0.24	+184	[21]2460	3.20	2644	3.44	2161	2.81	483	0.63
Feb.	6.54	6.92	5.97	4.22	+0.64	+492	[27]2650	3.45	3142	4.09	2212	2.88	930	1.21
Mar.	7.18	7.43	6.45	4.69	+0.36	+277	[27]2796	3.64	3073	4.00	2383	3.10	690	0.90
April	7.54	7.64	6.65	5.39	+0.38	+292	3075	4.00	3367	4.38	2372	3.09	995	1.29
May	7.92	8.20	7.14	5.91	+0.26	+200	3212	4.18	3412	4.44	2427	3.16	985	1.28
June	8.18	8.16	7.08	5.95	−0.16	−123	3074	4.00	2951	3.84	2465	3.21	486	0.63
July	8.02	7.88	6.90	5.67	−0.40	−307	3128	4.07	2821	3.67	2423	3.15	398	0.52
Aug.	7.62	7.37	6.39	5.17	−0.56	−430	2942	3.83	2512	3.27	2322	3.02	190	0.25
Sept.	7.06	6.76	5.82	4.72	−0.50	−384	2624	3.42	2240	2.92	2244	2.92	− 4	0.00
Oct.	6.56	6.37	5.45	4.40	−0.36	−277	2458	3.20	2181	2.84	2258	2.94	− 77	−0.10
Nov.	6.20	6.02	5.12	3.90	−0.32	−246	2519	3.28	2273	2.96	2125	2.77	148	0.19
Dec.	5.88	5.75	4.87	3.64	−0.28	−215	2449	3.19	2234	2.91	2170	2.82	64	0.09
1888														
Jan.	5.60	5.44	4.57	3.49	−0.23	−177	2225	2.90	2048	2.67	2094	2.73	− 46	−0.06
Feb.	5.37	5.30	4.44	2.27	+0.05	+ 38	[24]1996	2.60	2034	2.65	1954	2.54	80	0.10
Mar.	5.42	5.54	4.67	2.27	+0.44	+338	[27]2072	2.70	2410	3.14	1971	2.57	439	0.57
April	5.86	6.17	5.26	4.05	+0.34	+261	2555	3.33	2816	3.67	2121	2.76	695	0.91
May	6.20	6.24	5.33	4.20	+0.06	+ 46	2500	3.25	2546	3.31	2157	2.81	389	0.50
June	6.26	6.28	5.37	4.23	+0.05	+ 38	2523	3.28	2561	3.33	2197	2.86	364	0.47
July	6.31	6.34	5.42	4.22	−0.02	− 15	2599	3.38	2584	3.36	2251	2.93	333	0.43
Aug.	6.29	6.24	5.33	4.08	−0.25	−192	2615	3.40	2423	3.15	2225	2.90	198	0.25
Sept.	6.04	5.85	4.96	3.91	−0.37	−284	2311	3.01	2027	2.64	2142	2.79	−115	−0.15
Oct.	5.67	5.49	4.62	3.26	−0.21	−161	2475	3.22	2314	3.01	2098	2.73	216	0.28
Nov.	5.46	5.42	4.56	3.17	−0.04	− 31	2478	3.23	2447	3.19	2064	2.69	383	0.50
Dec.	5.42	5.41	4.55	3.30	+0.10	+ 77	2366	3.08	2443	3.18	2133	2.78	310	0.40
1889														
Jan.	5.52	5.62	4.74	3.51	+0.17	+131	2408	3.13	2539	3.30	2091	2.72	448	0.58
Feb.	5.69	5.76	4.88	2.87	+0.15	+115	[21]2207	2.87	2322	3.02	2041	2.66	281	0.37
Mar.	5.84	5.93	5 04	3.43	+0.21	+161	[24]2283	2.97	2444	3.18	1952	2.54	492	0.64
April	6.05	6.17	5.26	4.01	+0.19	+146	2594	3.38	2740	3.57	2038	2.65	702	0.92
May	6.24	6.32	5.40	4.19	+0.24	+184	2601	3.39	2785	3.63	2075	2.70	710	0.93
June	6.48	6.63	5.70	4.51	+0.24	+184	2678	3.49	2862	3.73	2186	2.85	676	0.88
July	6.72	6.82	5.88	4.61	−0.02	− 15	2819	3.67	2804	3.65	2196	2.86	608	0.79
Aug.	6.70	6.57	5.64	4.35	−0.41	−315	2754	3.58	2439	3.17	2174	2.83	265	0.34
Sept.	6.29	6.01	5.11	3.83	−0.50	−384	2571	3.35	2187	2.85	2084	2.71	103	0.14
Oct.	5.79	5.57	4.70	3.12	−0.42	−323	2666	3.47	2343	3.05	1970	2.56	373	0.49
Nov.	5.37	5.17	4.32	3.15	+0.09	+ 69	2228	2.90	2297	2.99	1970	2.56	327	0.43
Dec.	5.46	5.74	4.86	3.46	+0.54	+415	2264	2.95	2679	3.49	2041	2.66	638	0.83

a.—Niagara River discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.

NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gage observations taken at Locks 21, 24 and 27, respectively.

TABLE 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

DATE	WATER LEVELS OF—				STORAGE IN LAKE ONTARIO		OUTFLOW THROUGH ST. LAWRENCE RIVER		TOTAL SUPPLY TO LAKE ONTARIO		INFLOW FROM NIAGARA RIVER. *a*		LOCAL SUPPLY TO LAKE ONTARIO	
	LAKE ONTARIO		ST. LAWRENCE RIVER.											
	OSWEGO, N.Y.		Ogdensburg, N.Y., Mean of Month.	Lock 27, Head of Galop Canal, Mean of Month.										
	First of Month.	Mean of Month.			Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Feet Depth	100 c.f.s.	Feet Depth, Lake Ontario	100 c.f.s.	Foot Depth.
1890														
Jan.	246.00	246.25	245.34	244.10	+0.42	+323	[24]2589	3.37	2912	3.79	2178	2.83	734	0.96
Feb.	6.42	6.60	5.67	4.13	+0.34	+261	2614	3.40	2875	3.74	2133	2.78	742	0.96
Mar.	6.76	6.93	5.98	4.64	+0.29	+223	[24]2748	3.58	2971	3.87	2191	2.85	780	1.02
April	7.05	7.17	6.21	4.98	+0.30	+230	2890	3.76	3120	4.06	2251	2.93	869	1.13
May	7.35	7.53	6.59	5.26	+0.49	+376	3128	4.07	3504	4.56	2342	3.05	1162	1.51
June	7.84	8.16	7.00	5.89	+0.24	+184	3020	3.93	3204	4.17	2426	3.16	778	1.01
July	8.08	7.99	6.97	5.74	−0.42	−323	3155	4.11	2832	3.69	2354	3.06	748	0.62
Aug.	7.66	7.32	6.12	5.09	−0.52	−400	2643	3.44	2243	2.92	2237	2.91	6	0.01
Sept.	7.14	6.97	6.02	4.75	−0.34	−261	2866	3.73	2605	3.39	2152	2.80	453	0.59
Oct.	6.80	6.64	5.71	4.38	−0.12	− 92	2816	3.66	2724	3.54	2150	2.80	574	0.74
Nov.	6.68	6.72	5.78	4.32	−0.06	− 46	2956	3.85	2910	3.79	2196	2.86	714	0.93
Dec.	6.62	6.51	5.58	3.44	−0.27	−208	2591	3.37	2383	3.10	2133	2.78	250	0.32
1891														
Jan.	6.35	6.19	5.28	3.41	−0.03	− 23	[27]2404	3.13	2381	3.10	2072	2.70	309	0.40
Feb.	6.32	6.45	5.53	3.48	+0.40	+307	[27]2425	3.16	2732	3.56	2046	2.66	686	0.89
Mar.	6.72	6.99	6.04	4.30	+0.51	+392	[24]2649	3.45	3041	3.96	2077	2.70	964	1.25
April	7.23	7.47	6.49	5.13	+0.13	+100	3122	4.06	3222	4.19	2106	2.74	1116	1.45
May	7.36	7.25	6.28	4.93	−0.32	−246	3033	3.95	2787	3.63	2054	2.67	733	0.96
June	7.04	6.83	5.72	4.52	−0.35	−269	2693	3.51	2424	3.16	2050	2.67	374	0.49
July	6.69	6.55	5.49	4.38	−0.36	−277	2530	3.29	2253	2.93	2091	2.72	162	0.21
Aug.	6.33	6.11	5.07	3.99	−0.43	−330	2374	3.09	2044	2.66	2025	2.64	19	0.02
Sept.	5.90	5.68	4.71	3.50	−0.54	−415	2382	3.10	1967	2.56	1986	2.58	− 19	−0.02
Oct.	5.36	5.04	4.29	2.83	−0.62	−476	2440	3.18	1964	2.56	1903	2.48	61	0.08
Nov.	4.74	4.44	3.99	2.59	−0.32	−246	2299	2.99	2053	2.67	1891	2.46	162	0.21
Dec.	4.42	4.41	3.60	2.42	+0.04	+ 31	2023	2.63	2054	2.67	1897	2.47	157	0.20
1892														
Jan.	4.46	4.51	3.70	2.33	+0.04	+ 31	[24]2089	2.72	2120	2.76	1878	2.44	242	0.31
Feb.	4.50	4.48	3.67	1.83	+0.04	+ 31	[21]1851	2.41	1882	2.45	1733	2.26	149	0.19
Mar.	4.54	4.61	3.79	1.98	+0.36	+277	[21]1974	2.57	2251	2.93	1775	2.31	476	0.62
April	4.90	5.19	4.34	2.97	+0.32	+246	2392	3.11	2638	3.43	1954	2.54	684	0.89
May	5.22	5.25	4.40	3.16	+0.31	+238	2310	3.01	2548	3.32	2054	2.67	494	0.65
June	5.53	5.81	4.92	3.59	+0.53	+407	2549	3.32	2956	3.85	2246	2.92	710	0.93
July	6.06	6.32	5.26	4.21	+0.22	+169	2400	3.12	2569	3.34	2299	2.99	270	0.35
Aug.	6.28	6.24	5.15	4.03	−0.14	−108	2436	3.17	2328	3.03	2208	2.87	120	0.16
Sept.	6.14	6.04	5.21	3.87	−0.32	−246	2655	3.46	2409	3.14	2143	2.79	266	0.35
Oct.	5.82	5.60	4.67	3.44	−0.36	−277	2387	3.11	2110	2.75	2066	2.69	44	0.06
Nov.	5.46	5.33	4.36	3.09	−0.20	−154	2323	3.02	2169	2.82	1978	2.57	191	0.25
Dec.	5.26	5.20	4.35	3.10	−0.22	−169	2304	3.00	2135	2.78	1973	2.57	162	0.21
1893														
Jan.	5.04	4.87	4.04	2.27	−0.22	−169	[21]1752	2.28	1583	2.06	1806	2.35	−223	−0.29
Feb.	4.82	4.76	3.93	1.71	+0.18	+138	[27]1915	2.49	2053	2.67	1796	2.34	257	0.33
Mar.	5.00	5.24	4.39	2.29	+0.62	+476	[27]2077	2.70	2553	3.32	1861	2.42	692	0.90
April	5.62	5.99	5.09	3.66	+0.95	+730	2353	3.06	3083	4.01	2006	2.61	1077	1.40
May	6.57	7.15	6.19	4.80	+0.69	+530	3040	3.96	3570	4.65	2174	2.83	1396	1.82
June	7.26	7.37	6.39	5.12	−0.02	− 15	2994	3.90	2979	3.88	2258	2.94	721	0.94
July	7.24	7.11	6.15	4.81	−0.40	−307	2980	3.88	2673	3.48	2224	2.89	449	0.59
Aug.	6.84	6.57	5.64	4.27	−0.40	−307	2826	3.68	2519	3.28	2086	2.71	433	0.57
Sept.	6.44	6.30	5.39	4.17	−0.40	−307	2608	3.39	2301	2.99	2028	2.64	273	0.35
Oct.	6.04	5.78	4.90	3.60	−0.46	−353	2519	3.28	2166	2.82	2006	2.61	160	0.21
Nov.	5.58	5.37	4.51	3.20	−0.28	−215	2400	3.12	2185	2.84	2001	2.60	184	0.24
Dec.	5.30	5.22	4.37	3.08	+0.09	+ 69	2339	3.04	2408	3.13	1993	2.59	415	0.54
1894														
Jan.	5.39	5.56	4.69	3.16	+0.26	+200	2297	2.99	2497	3.25	1993	2.59	504	0.66
Feb.	5.65	5.74	4.86	2.44	+0.24	+184	[21]1990	2.59	2174	2.83	1908	2.48	266	0.35
Mar.	5.89	6.04	5.14	3.49	+0.17	+131	[27]2428	3.16	2559	3.33	1931	2.51	628	0.82
April	6.06	6.09	5.19	3.82	+0.12	+ 92	2673	3.48	2765	3.60	1974	2.57	791	1.03
May	6.18	6.27	5.36	4.04	+0.36	+277	2687	3.50	2964	3.86	2088	2.72	876	1.14
June	6.54	6.80	5.86	4.61	+0.16	+123	2793	3.64	2916	3.80	2181	2.84	735	0.96
July	6.70	6.60	5.67	4.40	−0.39	−300	2746	3.57	2446	3.18	2150	2.80	296	0.38
Aug.	6.31	6.02	5.12	3.81	−0.55	−423	2600	3.38	2177	2.83	2040	2.66	137	0.17
Sept.	5.76	5.51	4.64	3.37	−0.38	−292	2410	3.14	2118	2.76	2002	2.61	116	0.11
Oct.	5.38	5.26	4.40	3.15	−0.28	−215	2319	3.02	2104	2.74	2002	2.61	102	0.13
Nov.	5.10	4.93	4.09	2.95	−0.34	−261	2136	2.78	1875	2.44	1962	2.55	− 87	−0.11
Dec.	4.76	4.58	3.76	2.39	−0.22	−169	2206	2.87	2037	2.65	1923	2.50	114	0.15

a.—Niagara River discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.

NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gage observations taken at Locks 21, 24 and 27, respectively.

TABLE 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

DATE	WATER LEVELS OF— LAKE ONTARIO OSWEGO, N.Y. First of Month.	Mean of Month.	ST. LAWRENCE RIVER. Ogdensburg, N.Y., Mean of Month.	Lock 27, Head of Galop Canal, Mean of Month.	STORAGE IN LAKE ONTARIO Foot Depth.	100 c.f.s.	OUTFLOW THROUGH ST. LAWRENCE RIVER 100 c.f.s.	Feet Depth, Lake Ontario.	TOTAL SUPPLY TO LAKE ONTARIO 100 c.f.s.	Feet Depth	INFLOW FROM NIAGARA RIVER. *a* 100 c.f.s.	Feet Depth, Lake Ontario	LOCAL SUPPLY TO LAKE ONTARIO 100 c.f.s.	Foot Depth.
1895														
Jan.	244.54	244.49	243.68	242.16	−0.08	− 62	1989	2.59	1927	2.51	1896	2.47	31	0.04
Feb.	4.46	4.43	3.62	1.32	−0.08	− 62	[21]1659	2.16	1597	2.08	1749	2.28	−152	−0.20
Mar.	4.38	4.33	3.53	1.59	+0.22	+169	[21]1774	2.31	1943	2.53	1733	2.26	210	0.27
April	4.60	4.88	4.05	2.64	+0.34	+261	2034	2.65	2295	2.99	1777	2.31	518	0.68
May	4.94	5.00	4.16	2.97	0.00	0	2197	2.86	2197	2.86	1850	2.41	347	0.45
June	4.94	4.88	4.05	2.81	−0.20	−154	2202	2.87	2048	2.67	1872	2.44	176	0.23
July	4.74	4.59	3.77	2.51	−0.28	−215	2134	2.78	1919	2.50	1867	2.43	52	0.07
Aug.	4.46	4.34	3.54	2.36	−0.29	−223	2006	2.61	1783	2.32	1838	2.39	− 55	−0.07
Sept.	4.17	4.00	3.22	2.11	−0.34	−261	1866	2.43	1605	2.09	1842	2.40	−237	−0.31
Oct.	3.83	3.66	2.90	1.77	−0.29	−223	1794	2.33	1571	2.04	1792	2.33	−221	−0.29
Nov.	3.54	3.41	2.66	1.56	−0.12	− 92	1710	2.23	1618	2.11	1691	2.20	−73	−0.09
Dec.	3.42	3.44	2.69	1.72	+0.20	+154	1625	2.11	1779	2.31	1744	2.27	35	0.04
1896														
Jan.	3.62	3.80	3.03	1.80	+0.41	+315	[24]1825	2.38	2140	2.79	1775	2.31	365	0.48
Feb.	4.03	4.26	3.46	1.93	+0.35	+269	1932	2.51	2201	2.86	1760	2.29	441	0.57
Mar.	4.38	4.49	3.68	1.86	+0.57	+438	[27]1956	2.55	2394	3.12	1687	2.20	707	0.92
April	4.95	5.41	4.55	3.06	+0.47	+361	2230	2.90	2591	3.37	1796	2.34	795	1.03
May	5.42	5.43	4.57	3.46	−0.03	− 23	2252	2.93	2229	2.90	1891	2.46	338	0.44
June	5.39	5.35	4.49	3.29	−0.17	−131	2306	3.00	2175	2.83	1893	2.46	282	0.37
July	5.22	5.08	4.24	3.17	−0.21	−161	2120	2.76	1959	2.55	1932	2.51	27	0.04
Aug.	5.01	4.94	4.10	3.02	−0.31	−238	2088	2.72	1850	2.41	1983	2.58	−133	−0.17
Sept.	4.70	4.46	3.65	2.54	−0.36	−277	1985	2.58	1708	2.22	1891	2.46	−183	−0.24
Oct.	4.34	4.23	3.43	2.32	−0.24	−184	1924	2.50	1740	2.26	1836	2.39	− 96	−0.13
Nov.	4.10	3.97	3.19	2.22	−0.13	−100	1754	2.28	1654	2.15	1842	2.40	−188	−0.25
Dec.	3.97	3.97	3.19	2.04	−0.05	− 38	1648	2.14	1610	2.09	1797	2.34	−187	−0.25
1897														
Jan.	3.92	3.88	3.10	1.91	−0.07	− 54	1890	2.46	1836	2.39	1875	2.44	− 39	−0.05
Feb.	3.85	3.82	3.05	1.75	+0.22	+169	[24]1783	2.32	1952	2.54	1781	2.32	171	0.22
Mar.	4.07	4.32	3.52	2.25	+0.57	+438	[21]1976	2.57	2414	3.14	1888	2.46	526	0.68
April	4.64	4.96	4.12	3.12	+0.54	+415	2022	2.63	2437	3.17	2004	2.61	433	0.56
May	5.18	5.40	4.54	3.34	+0.32	+246	2321	3.02	2567	3.34	2101	2.73	466	0.61
June	5.50	5.61	4.73	3.73	+0.11	+ 84	2198	2.86	2282	2.97	2097	2.73	185	0.24
July	5.61	5.61	4.73	3.64	−0.01	− 8	2280	2.97	2272	2.96	2093	2.72	179	0.24
Aug.	5.60	5.60	4.73	3.63	−0.25	−192	2290	2.98	2098	2.73	2066	2.69	32	0.04
Sept.	5.35	5.10	4.25	3.07	−0.57	−438	2215	2.88	1777	2.31	1984	2.58	−207	−0.27
Oct.	4.78	4.47	3.66	2.57	−0.34	−261	1972	2.57	1711	2.23	1886	2.45	−175	−0.22
Nov.	4.44	4.41	3.60	2.30	0.00	0	2108	2.74	2108	2.74	1895	2.47	213	0.27
Dec.	4.44	4.47	3.66	2.37	+0.12	+ 92	2120	2.76	2212	2.88	1921	2.50	291	0.38
1898														
Jan.	4.56	4.64	3.82	2.44	+0.30	+230	[21]2074	2.70	2304	3.00	1893	2.46	411	0.53
Feb.	4.86	5.08	4.24	2.52	+0.42	+323	[27]2143	2.79	2466	3.21	1870	2.43	596	0.78
Mar.	5.28	5.48	4.61	3.58	+0.42	+323	2191	2.85	2514	3.27	1951	2.54	563	0.73
April	5.70	5.92	5.03	3.21	+0.30	+230	2580	3.36	2810	3.66	2088	2.72	722	0.94
May	6.00	6.08	5.18	3.54	+0.10	+ 77	2878	3.75	2955	3.85	2119	2.76	836	1.09
June	6.10	6.13	5.23	3.59	−0.11	− 84	2898	3.77	2814	3.66	2128	2.77	686	0.89
July	5.99	5.85	4.96	3.32	−0.31	−238	2801	3.65	2563	3.34	2077	2.70	486	0.64
Aug.	5.68	5.50	4.63	3.24	−0.38	−292	2501	3.26	2209	2.88	2068	2.69	141	0.19
Sept.	5.30	5.09	4.24	2.85	−0.34	−261	2372	3.09	2111	2.75	1981	2.58	130	0.17
Oct.	4.96	4.84	4.01	2.58	−0.10	− 77	2327	3.03	2250	2.93	1943	2.53	307	0.40
Nov.	4.86	4.89	4.06	2.56	+0.04	+ 31	2390	3.11	2421	3.15	1965	2.56	456	0.59
Dec.	4.90	4.90	4.07	2.61	+0.04	+ 31	2069	2.69	2100	2.73	1978	2.57	122	0.16
1899														
Jan.	4.94	4.98	4.14	2.70	−0.01	− 8	2078	2.70	2070	2.69	1974	2.57	96	0.12
Feb.	4.93	4.88	4.05	2.24	+0.07	+ 54	[21]2063	2.69	2117	2.76	1875	2.44	242	0.31
Mar.	5.00	5.13	4.28	2.72	+0.41	+315	2190	2.85	2505	3.26	1929	2.51	576	0.75
April	5.41	5.69	4.81	3.35	+0.41	+315	2289	2.98	2604	3.39	1973	2.57	631	0.82
May	5.82	5.94	5.05	3.66	+0.18	+138	2644	3.44	2782	3.62	2036	2.65	746	0.97
June	6.00	6.07	5.17	3.84	0.00	0	2634	3.43	2634	3.43	2079	2.71	555	0.72
July	6.00	5.92	5.03	3.68	−0.31	−238	2603	3.39	2365	3.08	2066	2.69	299	0.39
Aug.	5.69	5.46	4.59	3.27	−0.49	−376	2434	3.17	2058	2.68	1983	2.58	75	0.10
Sept.	5.20	4.95	4.11	2.81	−0.45	−346	2266	2.95	1920	2.50	1941	2.53	− 21	−0.03
Oct.	4.75	4.55	3.74	2.40	−0.27	−208	2180	2.84	1972	2.57	1850	2.41	122	0.16
Nov.	4.48	4.42	3.61	2.28	−0.09	− 69	2135	2.78	2066	2.69	1866	2.43	200	0.26
Dec.	4.39	4.36	3.56	2.35	+0.11	+ 84	2034	2.65	2118	2.76	1954	2.54	164	0.22

a.—Niagara River discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.

NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gage observations taken at Locks 21, 24 and 27 respectively.

TABLE 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

DATE	WATER LEVELS OF—				STORAGE IN LAKE ONTARIO		OUTFLOW THROUGH ST. LAWRENCE RIVER		TOTAL SUPPLY TO LAKE ONTARIO		INFLOW FROM NIAGARA RIVER. *a*		LOCAL SUPPLY TO LAKE ONTARIO	
	LAKE ONTARIO		ST. LAWRENCE RIVER.											
	OSWEGO, N.Y.		Ogdensburg, N.Y., Mean of Month.	Lock 27, Head of Galop Canal, Mean of Month.										
	First of Month.	Mean of Month.			Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Feet Depth	100 c.f.s.	Feet Depth, Lake Ontario	100 c.f.s.	Foot Depth.
1900														
Jan.	244.50	244.63	243.81	242.30	+0.26	+200	2022	2.63	2222	2.89	1891	2.46	331	0.43
Feb.	4.76	4.88	4.05	2.35	+0.28	+215	[24]2063	2.69	2278	2.96	1878	2.44	400	0.52
Mar.	5.04	5.19	4.34	2.35	+0.46	+353	[21]1566	2.04	1919	2.50	1923	2.50	− 4	−0.01
April	5.50	5.80	4.91	3.38	+0.40	+307	2365	3.08	2672	3.48	1999	2.60	673	0.88
May	5.90	5.99	5.09	3.54	+0.05	+ 38	2781	3.62	2819	3.67	2038	2.65	781	1.02
June	5.95	5.91	5.02	3.70	−0.09	− 69	2575	3.35	2506	3.26	2056	2.68	450	0.58
July	5.86	5.82	4.93	3.64	−0.18	−138	2520	3.28	2382	3.10	2061	2.68	321	0.42
Aug.	5.68	5.54	4.67	3.26	−0.35	−269	2530	3.29	2261	2.94	2034	2.65	227	0.29
Sept.	5.33	5.12	4.14	3.01	−0.41	−315	2141	2.79	1826	2.38	1978	2.57	−152	−0.19
Oct.	4.92	4.72	3.85	2.62	−0.28	−215	2135	2.78	1920	2.50	1893	2.46	27	0.04
Nov.	4.64	4.55	3.69	2.37	+0.06	+ 46	2151	2.80	2197	2.86	1927	2.51	270	0.35
Dec.	4.70	4.84	3.96	2.65	+0.06	+ 46	2226	2.90	2272	2.96	1912	2.49	360	0.47
1901														
Jan.	4.76	4.68	3.78	2.48	−0.11	− 84	[27]2131	2.77	2047	2.66	1876	2.44	171	0.22
Feb.	4.65	4.62	3.55	2.13	−0.15	−115	1898	2.47	1783	2.32	1755	2.28	28	0.04
Mar.	4.50	4.39	3.38	1.88	+0.51	+392	1893	2.46	2285	2.97	1712	2.23	573	0.75
April	5.01	5.63	4.35	3.02	+0.76	+584	2364	3.08	2948	3.84	1760	2.29	1188	1.55
May	5.77	5.91	4.82	3.58	+0.18	+138	2442	3.18	2580	3.36	1786	2.32	794	1.04
June	5.95	5.99	4.99	3.70	−0.09	− 69	2538	3.30	2469	3.21	1896	2.47	573	0.75
July	5.86	5.74	4.81	3.50	−0.28	−215	2496	3.25	2281	2.97	1936	2.52	345	0.45
Aug.	5.58	5.42	4.53	3.21	−0.32	−246	2414	3.14	2168	2.82	1897	2.47	271	0.35
Sept.	5.26	5.10	4.26	2.97	−0.38	−292	2305	3.00	2013	2.62	1908	2.48	105	0.14
Oct.	4.88	4.65	3.84	2.46	−0.42	−323	2238	2.91	1915	2.49	1861	2.42	54	0.07
Nov.	4.46	4.28	3.44	2.00	−0.14	−108	2152	2.80	2044	2.66	1831	2.38	213	0.28
Dec.	4.32	4.36	3.54	2.18	+0.07	+ 54	2133	2.78	2187	2.85	1827	2.38	360	0.47
1902														
Jan.	4.39	4.42	3.57	1.24	−0.03	− 23	[27]1780	2.32	1757	2.29	1836	2.39	− 79	−0.10
Feb.	4.36	4.30	3.57	0.24	+0.26	+200	[27]1522	1.98	1722	2.24	1706	2.22	16	0.02
Mar.	4.62	4.95	4.14	2.44	+0.56	+430	[27]2120	2.76	2550	3.32	1739	2.26	811	1.06
April	5.18	5.40	4.67	3.24	+0.26	+200	2227	2.90	2427	3.16	1855	2.41	572	0.74
May	5.44	5.47	4.62	3.34	+0.07	+ 54	2411	3.14	2465	3.21	1906	2.48	559	0.73
June	5.51	5.55	4.71	3.44	+0.25	+192	2434	3.17	2626	3.42	1975	2.57	651	0.85
July	5.76	5.97	5.06	3.74	+0.28	+215	2590	3.37	2805	3.65	2130	2.77	675	0.88
Aug.	6.04	6.11	5.12	3.84	−0.16	−123	2573	3.35	2450	3.19	2110	2.75	340	0.44
Sept.	5.88	5.66	4.80	3.54	−0.34	−261	2451	3.19	2190	2.85	2031	2.64	159	0.21
Oct.	5.54	5.42	4.51	3.28	−0.30	−230	2337	3.04	2107	2.74	2053	2.67	54	0.07
Nov.	5.24	5.05	4.21	3.04	−0.27	−208	2196	2.86	1988	2.59	1995	2.60	−7	−0.01
Dec.	4.97	4.89	4.06	2.74	−0.07	− 54	2265	2.95	2211	2.88	2009	2.61	202	0.26
1903														
Jan.	4.90	4.92	3.97	2.54	+0.14	+108	[24]1970	2.56	2078	2.70	1961	2.55	117	0.15
Feb.	5.04	5.16	4.00	2.54	+0.42	+323	2049	2.67	2372	3.09	1897	2.47	475	0.62
Mar.	5.46	5.75	4.68	3.24	+0.64	+492	2236	2.91	2728	3.55	1992	2.59	736	0.96
April	6.10	6.44	5.48	4.14	+0.40	+307	2746	3.57	3053	3.97	2154	2.80	899	1.17
May	6.50	6.56	5.60	4.34	0.00	0	2711	3.53	2711	3.53	2159	2.81	552	0.72
June	6.50	6.44	5.43	4.14	+0.02	+ 15	2681	3.49	2696	3.51	2184	2.84	512	0.67
July	6.52	6.59	5.57	4.24	−0.05	− 31	2769	3.60	2738	3.56	2194	2.86	544	0.71
Aug.	6.47	6.35	5.35	4.04	−0.26	−200	2673	3.48	2473	3.22	2110	2.75	363	0.47
Sept.	6.21	6.07	5.13	3.54	−0.31	−238	2672	3.48	2434	3.17	2088	2.72	346	0.45
Oct.	5.90	5.72	4.70	3.44	−0.36	−277	2289	2.98	2012	2.62	2045	2.66	− 33	−0.04
Nov.	5.54	5.36	4.47	3.14	−0.30	−230	2272	2.96	2042	2.66	1966	2.56	76	0.10
Dec.	5.24	5.11	4.24	3.04	−0.32	−246	2176	2.83	1930	2.51	1968	2.56	− 38	−0.05
1904														
Jan.	4.92	4.72	3.90	2.54	−0.06	− 46	[21]1973	2.57	1927	2.51	1762	2.29	165	0.21
Feb.	4.86	5.00	4.04	2.54	+0.46	+353	1969	2.56	2322	3.02	1813	2.36	509	0.66
Mar.	5.32	5.63	4.47	3.04	+1.00	+768	2048	2.67	2816	3.67	1931	2.51	885	1.16
April	6.32	7.00	5.86	4.54	+0.98	+753	2369	3.08	3122	4.06	2170	2.82	952	1.24
May	7.30	7.61	6.45	5.35	+0.44	+338	2675	3.48	3013	3.92	2252	2.93	761	0.99
June	7.74	7.87	6.75	5.54	+0.14	+108	2888	3.76	2996	3.90	2317	3.02	679	0.88
July	7.88	7.89	6.82	5.74	−0.12	− 92	2767	3.60	2675	3.48	2296	2.99	379	0.49
Aug.	7.76	7.64	6.64	5.38	−0.32	−246	2904	3.78	2658	3.46	2225	2.90	433	0.56
Sept.	7.44	7.25	6.22	5.00	−0.38	−292	2726	3.55	2434	3.17	2157	2.81	277	0.36
Oct.	7.06	6.87	5.89	4.65	−0.44	−338	2640	3.44	2302	3.00	2103	2.74	199	0.26
Nov.	6.62	6.36	5.36	4.08	−0.54	−415	2508	3.26	2093	2.72	2033	2.65	60	0.07
Dec.	6.08	5.81	4.81	3.34	−0.28	−215	2169	2.82	1954	2.54	1993	2.59	− 39	−0.05

a.—Niagara River discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.

NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gage observations taken at Locks 21 24 and 27, respectively.

TABLE 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

DATE	WATER LEVELS OF—				STORAGE IN LAKE ONTARIO		OUTFLOW THROUGH ST. LAWRENCE RIVER		TOTAL SUPPLY TO LAKE ONTARIO		INFLOW FROM NIAGARA RIVER. *a*		LOCAL SUPPLY TO LAKE ONTARIO	
	LAKE ONTARIO		ST. LAWRENCE RIVER.											
	OSWEGO, N.Y.		Ogdensburg, N.Y.	Lock 27, Head of Galop Canal,										
	First of Month.	Mean of Month.	Mean of Month.	Mean of Month.	Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Feet Depth	100 c.f.s.	Feet Depth, Lake Ontario	100 c.f.s.	Foot Depth.
1905														
Jan.	245.80	245.79	244.91	243.08	−0.16	−123	[21]1968	2.56	1845	2.40	1906	2.48	− 61	−0.08
Feb.	5.64	5.49	4.53	2.78	−0.25	−192	[21]1779	2.32	1587	2.07	1797	2.34	−210	−0.27
Mar.	5.39	5.29	4.24	2.44	+0.32	+246	[21]1886	2.45	2132	2.77	1816	2.36	316	0.41
April	5.71	6.13	5.09	3.68	+0.48	+369	2211	2.88	2580	3.36	1917	2.49	663	0.86
May	6.19	6.25	5.28	4.04	+0.23	+177	2449	3.19	2626	3.42	2049	2.67	577	0.75
June	6.42	6.59	5.64	4.28	+0.36	+277	2666	3.47	2943	3.83	2188	2.85	755	0.98
July	6.78	6.98	5.95	4.70	+0.16	+123	2668	3.47	2791	3.36	2264	2.95	527	0.69
Aug.	6.94	6.90	5.85	4.44	−0.12	− 92	2778	3.62	2686	3.50	2209	2.87	477	0.62
Sept.	6.82	6.75	5.76	4.44	−0.22	−169	2671	3.48	2502	3.26	2161	2.81	341	0.44
Oct.	6.60	6.45	5.48	4.28	−0.34	−261	2475	3.22	2214	2.88	2112	2.75	102	0.13
Nov.	6.26	6.07	5.24	3.88	−0.28	−215	2536	3.30	2321	3.02	2029	2.64	292	0.38
Dec.	5.98	5.88	5.03	3.58	+0.02	+ 15	2220	2.89	2235	2.91	2066	2.69	169	0.22
1906														
Jan.	6.00	6.13	5.30	3.98	+0.11	+ 84	[21]2403	3.13	2487	3.24	2038	2.65	449	0.58
Feb.	6.11	6.09	5.11	3.66	−0.11	− 84	2244	2.92	2160	2.81	1936	2.52	224	0.29
Mar.	6.00	5.91	4.95	3.51	+0.08	+ 62	2191	2.85	2253	2.93	1889	2.46	364	0.47
April	6.08	6.25	5.21	3.86	+0.24	+184	2518	3.28	2702	3.52	1977	2.57	725	0.94
May	6.32	6.38	5.38	4.01	+0.08	+ 62	2589	3.37	2651	3.45	2025	2.64	626	0.81
June	6.40	6.41	5.42	4.14	+0.09	+ 69	2527	3.29	2596	3.38	2075	2.70	521	0.68
July	6.49	6.57	5.56	4.24	−0.07	− 54	2606	3.39	2552	3.32	2091	2.72	461	0.60
Aug.	6.42	6.26	5.31	3.96	−0.38	−292	2551	3.32	2259	2.94	2078	2.70	181	0.24
Sept.	6.04	5.81	4.92	3.52	−0.40	−307	2464	3.21	2157	2.81	2025	2.64	132	0.17
Oct.	5.64	5.48	4.68	3.42	−0.11	− 84	2283	2.97	2199	2.86	2020	2.63	179	0.23
Nov.	5.53	5.58	4.62	3.38	+0.13	+100	2249	2.93	2349	3.06	2036	2.65	313	0.41
Dec.	5.66	5.74	4.64	3.29	+0.38	+292	2339	3.04	2631	3.42	2066	2.69	565	0.74
1907														
Jan.	6.04	6.34	5.20	3.35	+0.36	+277	[21]2266	2.95	2543	3.31	2185	2.84	358	0.47
Feb.	6.40	6.46	5.42	3.47	+0.06	+ 46	[21]2207	2.87	2253	2.93	2070	2.69	183	0.24
Mar.	6.46	6.47	5.32	3.63	+0.20	+154	[21]2291	2.98	2445	3.18	2014	2.62	431	0.56
April	6.66	6.85	5.74	4.42	+0.30	+230	2664	3.47	2894	3.77	2105	2.74	789	1.03
May	6.96	7.08	6.03	4.73	+0.14	+108	2741	3.57	2849	3.71	2157	2.81	692	0.90
June	7.10	7.11	6.05	4.78	+0.02	+ 15	2720	3.54	2735	3.56	2239	2.91	496	0.65
July	7.12	7.12	6.12	4.85	−0.11	− 84	2742	3.57	2658	3.46	2276	2.96	382	0.50
Aug.	7.01	6.90	5.90	4.63	−0.31	−238	2672	3.48	2434	3.17	2200	2.86	234	0.30
Sept.	6.70	6.50	5.51	4.19	−0.21	−181	2590	3.37	2429	3.16	2148	2.80	281	0.37
Oct.	6.49	6.48	5.42	4.16	−0.09	− 69	2509	3.27	2440	3.18	2145	2.79	295	0.38
Nov.	6.40	6.33	5.31	4.06	−0.07	− 54	2467	3.21	2413	3.14	2126	2.77	287	0.37
Dec.	6.33	6.33	5.34	3.93			2284	2.97			2108	2.74		

Niagara River discharge values indicate a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.

NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gage observations taken at Locks 21, 24 and 27, respectively.

TABLE 28. MEAN MONTHLY SUPPLY FACTORS OF THE GREAT LAKES, 1860-1907, INCLUSIVE.

SUPPLY FACTORS.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
LAKE SUPERIOR.												
Stage, in feet above mean sea level	602.03	601.85	601.77	601.86	602.16	602.42	602.63	602.73	602.79	602.74	602.56	602.26
Storage, in 100 c.f.s.	−718	−409	− 13	+650	+959	+809	+525	+267	+ 6	−385	−803	−911
Outflow, in 100 c.f.s.	741	701	680	703	798	857	908	927	928	913	875	804
Total Supply, in 100 c.f.s.	23	292	668	1353	1757	1666	1433	1193	934	528	73	−107
Local Supply, in 100 c.f.s.	23	292	668	1353	1757	1666	1433	1193	934	528	73	−107
LAKE MICHIGAN-HURON.—*a*.												
Stage, in feet above mean sea level	580.93	580.93	581.05	581.25	581.55	581.79	581.90	581.86	581.67	581.45	581.21	580.99
Storage, in 100 c.f.s.	−265	+286	+792	+1222	+1323	+864	+150	−571	−987	−1122	−1120	− 794
Outflow, in 100 c.f.s.—*b*.	1919	1763	1873	2003	2053	2155	2202	2204	2163	2117	2082	2052
Total Supply, in 100 c.f.s.	1654	2049	2664	3225	3377	3019	2352	1633	1176	995	962	1258
Local Supply, in 100 c.f.s.	913	1347	1984	2522	2578	2162	1442	706	247	82	87	453
LAKE ERIE.												
Stage, in feet above mean sea level	572.10	572.03	572.22	572.70	573.05	573.24	573.22	573.04	572.78	572.45	572.21	572.14
Storage, in 100 c.f.s.	− 68	+ 59	+366	+441	+276	+ 90	−108	−232	−311	−303	− 165	− 64
Outflow, in 100 c.f.s.—*c*	2044	1981	2012	2116	2192	2251	2263	2203	2152	2095	2063	2085
Total Supply, in 100 c.f.s.	1976	2040	2378	2557	2469	2340	2154	1971	1841	1792	1898	2020
Local Supply, in 100 c.f.s.	+ 64	+284	+513	+561	+422	+192	− 41	−227	−316	−318	−177	− 24
LAKE ONTARIO.												
Stage, in feet above mean sea level	245.58	245.65	245.91	246.49	246.82	246.95	246.93	246.63	246.22	245.88	245.63	245.57
Storage, in 100 c.f.s.	+ 28	+127	+323	+348	+179	+ 44	−124	−273	−287	−226	−120	− 24
Outflow, in 100 c.f.s.	2228	2193	2333	2606	2795	2835	2836	2750	2621	2526	2450	2341
Total Supply, in 100 c.f.s.	2255	2320	2656	2954	2975	2880	2712	2477	2334	2300	2329	2318
Local Supply, in 100 c.f.s.	211	340	644	838	782	629	449	274	182	206	266	228

a.—Lake St. Clair included as part of Lake Michigan-Huron Watershed.

b.—This quantity includes the flow through the Chicago Drainage Canal since 1900.

c.—This quantity includes a flow of 1000 c.f.s. through the Erie Canal, and 1100 c.f.s. through the Welland Canal.

TABLE 31

MEAN MONTHLY SUPPLY FACTORS OF THE GREAT LAKES EXPRESSED IN CUBIC FEET PER SECOND PER SQUARE MILE OF WATERSHED, 1860-1907 INCLUSIVE.

SUPPLY FACTORS.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
LAKE SUPERIOR.												
Storage, c.f.s. per square mile	−0.94	−0.54	−0.02	+0.85	+1.26	+1.06	+0.69	+0.35	+0 01	−0.51	−1.06	−1.20
Outflow, c.f.s. per square mile	0.97	0.92	0.89	0.92	1.05	1.13	1.19	1.22	1.22	1.20	1.15	1.06
Total Supply, c.f.s per square mile	0 03	0 38	0.88	1.78	2.31	2.19	1.88	1.57	1.23	0.69	0.10	−0.14
Local Supply, c.f.s. per square mile	0.03	0.38	0.88	1.78	2.31	2.19	1.88	1.57	1.23	0.69	0.10	−0.14
LAKE MICHIGAN-HURON.—*a.*												
Storage, c.f.s. per square mile	−0.12	+0.13	+0.36	+0.56	+0.60	+0.39	+0.07	−0.26	−0.45	−0.51	−0.51	−0.36
Outflow, c.f s. per square mile.—*b*	0.87	0.80	0.85	0.91	0.93	0.98	1.00	1.00	0 98	0.96	0.95	0.93
Total Supply, c.f.s. per square mile	0.75	0.93	1.21	1.46	1.53	1.37	1.07	0.74	0.53	0.45	0 44	0.57
Local Supply, c.f.s. per square mile	0.63	0.94	1.38	1.75	1.50	1.00	1.00	0.49	0.17	0.06	0.06	0.32
LAKE ERIE.												
Storage, c.f.s per square mile	−0.03	+0 02	+0.14	+0.17	+0.11	+0.04	−0.04	−0.09	−0.12	−0.12	−0.06	−0.02
Outflow, c.f.s. per square mile.—*c*	0.80	0.78	0.79	0.83	0.86	0.88	0.89	0.86	0.84	0.82	0.81	0.82
Total Supply, c.f.s per square mile	0.78	0.80	0.93	1.00	0.97	0.92	0.85	0.77	0.72	0.70	0.74	0.79
Local Supply c.f.s. per square mile	+0.18	+0.82	+1.48	+1.62	+1.22	+0.56	−0.12	−0.66	−0.91	−0.92	−0.51	−0.07
LAKE ONTARIO.												
Storage, c.f.s per square mile	+0.01	+0.04	+0.11	+0.12	+0.06	+0.02	−0.04	−0.10	−0.10	−0.08	−0.04	−0.01
Outflow, c.f.s. per square mile	0.77	0.76	0.81	0.91	0.97	0.98	0.99	0.96	0.91	0.88	0.85	0.81
Total Supply, c.f.s. per square mile	0.78	0.81	0.92	1.03	1.03	1.00	0.94	0.86	0.81	0.80	0.81	0.81
Local Supply, c.f.s. per square mile	0.64	1.03	1.95	2.54	2.37	1.91	1.36	0.83	0.55	0.62	0.81	0.69

a.—Lake St. Clair included as part of Lake Michigan-Huron Watershed.

b.—This quantity includes the flow through the Chicago Drainage Canal since 1900.

c.—This quantity includes the flow through the Erie Canal and through the Welland Canal.

TABLE 33. REGULATION OF LAKE ERIE BETWEEN STAGES 573.7 AND 574.7.

DATE	WATER LEVELS OF LAKE ERIE. CLEVELAND, O. First of Month	CLEVELAND, O. Mean of Month	BUFFALO, N.Y. First of Month	BUFFALO, N.Y. Mean of Month	STORAGE IN LAKE ERIE Foot Depth	STORAGE IN LAKE ERIE 100 c.f.s.	OUTFLOW THROUGH NIAGARA RIVER, 100 c.f.s. a	TOTAL SUPPLY TO LAKE ERIE, 100 c.f.s. a	EXPECTED CHANGE IN TOTAL SUPPLY OVER PRECEDING MONTH, 100 c.f.s.	EXPECTED TOTAL SUPPLY FOR MONTH, 100 c.f.s.	EXPECTED TOTAL SUPPLY MINUS TOTAL SUPPLY, 100 c.f.s.	REGULATED LAKE LEVEL DESIRED, BUFFALO, N.Y. First of Month.	CHANGE IN STAGE REQUIRED BY LAST OF MONTH Foot Depth.	CHANGE IN OUTFLOW TO GIVE CHANGE IN PRECEDING COLUMN, 100 c.f.s.	EXPECTED REGULATED OUTFLOW FOR MONTH, 100 c.f.s.	REGULATED OUTFLOW FOR FIRST OF MONTH, 100 c.f.s.	REGULATED STORAGE IN LAKE ERIE. 100 c.f.s.	REGULATED STORAGE IN LAKE ERIE. Foot Depth	REGULATED LAKE LEVEL, BUFFALO, N.Y. First of Month.	REGULATED LEVEL MINUS REGULATED LEVEL DESIRED, First of Month.	REGULATED LAKE LEVEL MINUS ACTUAL LAKE LEVEL, BUFFALO, N.Y. First of Month	REGULATED LAKE LEVEL MINUS ACTUAL LAKE LEVEL, BUFFALO, N.Y. Mean of Month	REGULATED LAKE LEVEL, BUFFALO, N.Y. Mean of Month.	SLUICE GATES.
1890																								
Jan.	572.20	572.38	572.64	572.93	+0.32	+338	2157	2495	− 44	2304	−191	573.8	−0.10	+ 106	2410	2374	+121	+0.10	573.80	0.00	1.16	1.11	574.04	Open
Feb.	2.52	2.67	2.84	2.74	+0.21	+222	2112	2334	+ 64	2559	+225	3.7	−0.20	+ 211	2770	2400	− 66	−0.06	3.90	+0.20	1.06	1.02	3.76	Open
Mar.	2.73	2.79	2.86	2.98	+0.31	+328	2170	2498	+338	2672	+174	3.7	−0.04	+ 42	2714	2384	+114	+0.10	3.84	+0.14	0.98	0.91	3.89	Open
April	3.04	3.28	3.10	3.23	+0.41	+434	2230	2664	+179	2677	+ 13	3.8	−0.04	+ 42	2719	2410	+254	+0.21	3.94	+0.14	0.84	0.79	4.02	Open
May	3.45	3.62	3.41	3.59	+0.59	+370	2321	2691	−88	2576	−115	3.9	−0.15	+ 159	2735	2466	+225	+0.19	4.15	+0.25	0.74	0.66	4.25	Open
June	3.80	3.99	3.76	3.92	0.00	0	2405	2405	−129	2562	+157	4.0	−0.34	+ 360	2922	2516	−111	−0.09	4.34	+0.34	0.58	0.52	4.44	Open
July	3.80	3.61	3.78	3.64	−0.42	−444	2333	1889	−186	2219	+330	4.0	−0.25	+2.64	2483	2483	−594	−0.50	4.25	+0.25	0.47	0.41	4.05	Part
Aug.	3.38	3.15	3.40	3.17	−0.32	−338	2216	1878	−183	1706	−172	4.0	+0.25	− 264	1442	1667	+211	+0.20	3.75	−0.25	0.35	0.65	3.82	Mln.
Sept.	3.06	2.98	3.00	2.82	−0.18	−190	2131	1941	−130	1748	−193	4.0	+0.05	− 53	1695	1695	+246	+0.21	3.95	−0.05	0.95	1.14	3.96	Part
Oct.	2.88	2.79	2.82	2.81	−0.10	−106	2129	2023	− 49	1892	−131	4.0	−0.16	+ 169	2061	2061	− 38	−0.03	4.16	+0.16	1.34	1.28	4.09	Part
Nov.	2.78	2.76	2.90	3.00	−0.14	−148	2175	2027	+106	2129	+102	4.0	−0.23	+ 243	2372	2372	−345	−0.29	4.13	+0.13	1.23	1.10	4.10	Part
Dec.	2.64	2.53	2.87	2.74	−0.22	−233	2112	1879	+122	2149	+270	3.9	−0.04	+ 42	2191	2191	−312	−0.26	3.84	−0.06	0.97	0.97	3.71	Part
1891																								
Jan.	2.42	2.31	2.61	2.48	−0.12	−127	2051	1924	− 44	1835	− 89	3.8	+0.12	− 127	1708	1708	+216	+0.18	3.58	−0.22	0.97	1.16	3.64	Part
Feb.	2.30	2.29	2.42	2.36	+0.22	+233	2025	2258	+ 64	1988	−270	3.7	−0.06	+ 63	2051	2051	+207	+0.17	3.76	+0.06	1.34	1.42	3.78	Part
Mar.	2.52	2.75	2.43	2.50	+0.16	+169	2056	2225	+338	2596	+371	3.7	−0.13	+ 137	2733	2408	−183	−0.15	3.93	+0.23	1.50	1.36	3.86	Open
April	2.68	2.62	2.56	2.62	−0.15	−159	2085	1926	+179	2404	+478	3.8	+0.12	− 127	2277	2277	−351	−0.30	3.78	−0.02	1.22	1.10	3.72	Part
May	2.53	2.44	2.51	2.40	−0.02	− 21	2033	2012	− 88	1838	−174	3.9	+0.52	− 550	1288	1667	+345	+0.33	3.48	−0.42	0.97	1.20	3.60	Mln.
June	2.51	2.58	2.39	2.38	+0.02	+ 21	2029	2050	−129	1883	−167	4.0	+0.19	− 201	1682	1682	+368	+0.31	3.81	−0.19	1.42	1.54	3.92	Part
July	2.53	2.48	2.47	2.56	−0.19	−201	2070	1869	−186	1864	− 5	4.0	−0.12	+ 127	1991	1991	−122	−0.10	4.12	+0.12	1.65	1.62	4.18	Part
Aug.	2.31	2.21	2.42	2.27	−0.22	−233	2004	1771	−183	1686	− 85	4.0	−0.02	+ 21	1707	1707	+ 64	+0.05	4.02	+0.02	1.60	1.74	4.01	Part
Sept.	2.12	2.03	2.18	2.10	−0.28	−296	1965	1659	−130	1641	− 28	4.0	−0.07	+ 74	1715	1715	− 46	−0.04	4.07	+0.07	1.89	2.00	4.10	Part
Oct.	1.84	1.65	1.92	1.73	−0.41	−434	1882	1448	− 49	1620	+172	4.0	−0.03	+ 32	1652	1667	−219	−0.21	4.03	+0.03	2.11	2.12	3.85	Mln
Nov.	1.43	1.21	1.70	1.67	−0.19	−201	1870	1669	+106	1554	−115	4.0	+0.08	− 85	1469	1667	+ 2	0.00	3.82	−0.18	2.12	2.13	3.80	Mln.
Dec.	1.24	1.28	1.68	1.70	+0.06	+ 63	1876	1939	+122	1791	−148	3.9	−0.02	+ 21	1812	1812	+127	+0.11	3.82	−0.08	2.14	2.20	3.90	Part
1892																								
Jan.	1.30	1.31	1.66	1.61	−0.10	−106	1857	1751	− 44	1895	+144	3.8	−0.23	+ 243	2138	2138	−387	−0.32	3.93	+0.13	2.27	2.31	3.92	Part
Feb.	1.20	1.10	1.26	0.92	−0.08	− 85	1712	1627	+ 64	1815	+188	3.7	+0.09	− 95	1720	1720	− 93	−0.08	3.61	−0.09	2.35	2.43	3.35	Part
Mar.	1.12	1.14	1.02	1.12	+0.30	+317	1754	2071	+338	1965	−106	3.7	+0.27	− 286	1679	1679	+392	+0.33	3.53	−0.17	2.51	2.42	3.54	Part
April	1.42	1.70	1.54	1.96	+0.68	+719	1933	2652	+179	2250	−402	3.8	+0.04	− 42	2208	2208	+444	+0.37	3.86	+0.06	2.32	2.18	4.14	Part
May	2.10	2.50	2.18	2.40	+0.78	+825	2033	2858	− 88	2564	−294	3.9	−0.23	+ 243	2807	2487	+371	+0.31	4.23	+0.33	2.05	1.90	4.30	Open
June	2.88	3.26	2.80	3.21	+0.44	+465	2225	2690	−129	2729	+ 39	4.0	−0.54	+ 571	3300	2571	+119	+0.10	4.54	+0.54	1.74	1.53	4.74	Open

a.—The flow of 1000 c.f.s. through the Erie Canal, and that of 1100 c.f.s. through the Welland Canal have been omitted.

TABLE 33.—Continued. REGULATION OF LAKE ERIE BETWEEN STAGES 573.7 AND 574.7.

DATE	WATER LEVELS OF LAKE ERIE. CLEVELAND, O. First of Month.	CLEVELAND, O. Mean of Month	BUFFALO, N.Y. First of Month	BUFFALO, N.Y. Mean of Month	STORAGE IN LAKE ERIE Foot Depth	STORAGE IN LAKE ERIE 100 c.f.s.	OUTFLOW THROUGH NIAGARA RIVER, 100 c.f.s. *a*	TOTAL SUPPLY TO LAKE ERIE, 100 c.f.s. *a*	EXPECTED CHANGE IN TOTAL SUPPLY OVER PRECEDING MONTH, 100 c.f.s.	EXPECTED TOTAL SUPPLY FOR MONTH, 100 c.f.s.	EXPECTED TOTAL SUPPLY MINUS TOTAL SUPPLY, 100 c.f.s.	REGULATED LAKE LEVEL DESIRED, BUFFALO, N.Y. First of Month.	CHANGE IN STAGE REQUIRED BY LAST OF MONTH Foot Depth.	CHANGE IN OUTFLOW TO GIVE CHANGE IN PRECEDING COLUMN, 100 c.f.s.	EXPECTED REGULATED OUTFLOW FOR MONTH, 100 c.f.s.	REGULATED OUTFLOW FOR FIRST OF MONTH, 100 c.f.s.	REGULATED STORAGE IN LAKE ERIE. 100 c.f.s.	REGULATED STORAGE IN LAKE ERIE. Foot Depth	REGULATED LAKE LEVEL, BUFFALO, N.Y. First of Month.	REGULATED LEVEL MINUS REGULATED LEVEL DESIRED, First of Month.	REGULATED LAKE LEVEL MINUS ACTUAL LAKE LEVEL, BUFFALO, N.Y. First of Month	REGULATED LAKE LEVEL MINUS ACTUAL LAKE LEVEL, BUFFALO, N.Y. Mean of Month	REGULATED LAKE LEVEL, BUFFALO, N.Y. Mean of Month.	SLUICE GATES.
1892																								
July	573.32	573.38	573.32	573.42	−0.12	−127	2278	2151	−186	2504	+353	574.0	−0.64	+ 677	3181	2598	−447	−0.38	574.64	+0.64	1.32	1.17	574.59	Open
Aug.	3.20	3.03	3.24	3.05	−0.33	−349	2187	1838	−183	1968	+130	4.0	−0.26	+ 275	2243	2243	−405	−0.34	4.26	+0.26	1.02	1.01	4.06	Part
Sept.	2.87	2.71	2.92	2.78	−0.44	−465	2122	1657	−130	1708	+ 51	4.0	+0.08	− 85	1623	1667	− 10	−0.01	3.92	−0.08	1.00	1.00	3.92	Min.
Oct.	2.43	2.15	2.62	2.45	−0.45	−476	2045	1569	− 49	1608	+ 39	4.0	+0.09	− 95	1513	1667	− 98	−0.09	3.91	−0.09	1.29	1.42	3.87	Min.
Nov.	1.98	1.82	2.26	2.07	−0.30	−317	1957	1640	+106	1675	+ 35	4.0	+0.08	− 85	1590	1667	− 27	−0.03	3.82	−0.18	1.56	1.64	3.71	Min.
Dec.	1.68	1.55	2.06	2.01	−0.32	−338	1952	1614	+122	1762	+148	3.9	+0.01	− 11	1751	1751	−137	−0.12	3.79	−0.11	1.73	1.87	3.91	Part
1893																								
Jan.	1.36	1.17	1.66	1.27	−0.15	−159	1785	1626	− 44	1570	− 56	3.8	+0.03	− 32	1538	1667	− 41	−0.04	3.67	0.13	2.01	2.20	−3.47	Min
Feb.	1.21	1.25	1.24	1.22	+0.15	+159	1775	1934	+ 64	1690	−244	3.7	+0.07	− 74	1616	1667	+267	+0.25	3.63	−0.07	2.39	2.44	3.66	Min
Mar.	1.36	1.47	1.38	1.53	+0.48	+508	1840	2348	+338	2272	− 76	3.7	−0.08	+ 85	2357	2357	− 29	−0.01	3.88	+0.18	2.50	2.26	3.79	Part
April	1.84	2.20	1.86	2.19	+0.78	+825	1985	2810	+179	2527	−283	3.8	+0.03	− 32	2495	2392	+418	+0.35	3.87	+0.07	2.01	1.84	4.03	Open
May	2.62	3.04	2.55	2.91	+0.52	+550	2153	2703	− 88	2722	+ 19	3.9	−0.22	+ 233	2955	2484	+219	+0.18	4.22	+0.32	1.67	1.50	4.41	Open
June	3.14	3.23	3.08	3.26	−0.05	− 53	2237	2184	−129	2574	+390	4.0	−0.40	+ 423	2997	2532	−348	−0.29	4.40	+0.40	1.32	1.12	4.38	Open
July	3.09	2.95	3.20	3.13	−0.31	−328	2203	1875	−186	1998	+123	4.0	−0.11	+ 116	2114	2114	−239	−0.20	4.11	+0.11	0.91	0.99	4.12	Part
Aug.	2.78	2.61	2.84	2.54	−0.36	−381	2065	1684	−183	1692	+ 8	4.0	+0.09	− 95	1597	1667	+ 17	+0.02	3.91	−0.09	1.07	1.29	3.83	Min.
Sept.	2.42	2.23	2.42	2.29	−0.36	−381	2007	1626	−130	1554	− 72	4.0	+0.07	− 74	1480	1667	− 41	−0.04	3.93	−0.07	1.51	1.58	3.87	Min.
Oct.	2.06	1.88	2.24	2.19	−0.38	−402	1985	1583	− 49	1577	− 6	4.0	+0.11	− 116	1461	1667	− 84	−0.08	3.89	−0.11	1.65	1.64	3.83	Min.
Nov.	1.68	1.48	2.18	2.17	−0.16	−169	1980	1811	+106	1689	−122	4.0	+0.09	− 95	1594	1667	+144	+0.14	3.81	−0.19	1.63	1.72	3.89	Min.
Dec.	1.52	1.56	2.15	2.13	+0.18	+190	1972	2162	+122	1933	−229	3.9	−0.15	+ 159	2092	2092	+ 70	+0.06	3.95	+0.05	1.80	1.84	3.97	Part
1894																								
Jan.	1.70	1.84	2.13	2.13	+0.08	+ 85	1972	2057	− 44	2118	+ 61	3.8	−0.31	+ 328	2446	2429	−372	−0.31	4.01	+0.21	1.88	1.82	3.95	Open
Feb.	1.78	1.72	1.94	1.75	+0.04	− 42	1887	1845	+ 64	2121	+276	3.7	0.00	0	2121	2121	−276	−0.23	3.70	0.00	1.76	1.72	3.47	Part
Mar.	1.74	1.75	1.80	1.86	+0.21	+222	1910	2132	+338	2183	+ 51	3.7	+0.33	− 349	1834	1834	+298	+0.25	3.47	−0.23	1.67	1.72	3.58	Part
April	1.95	2.15	1.96	2.05	+0.39	+412	1953	2365	+179	2311	− 54	3.8	+0.18	− 190	2121	2121	+244	+0.21	3.72	−0.08	1.76	1.70	3.75	Part
May	2.34	2.54	2.30	2.55	+0.30	+317	2067	2384	− 88	2277	−107	3.9	+0.07	− 74	2203	2203	+181	+0.15	3.93	+0.03	1.63	1.48	4.03	Part
June	2.64	2.75	2.74	2.94	+0.10	+106	2160	2266	−129	2255	− 11	4.0	−0.08	+ 85	2340	2340	− 74	−0.06	4.08	+0.08	1.34	1.24	4.18	Part
July	2.74	2.73	2.88	2.81	−0.20	−211	2129	1918	−186	2080	+162	4.0	−0.02	+ 21	2101	2101	−183	−0.15	4.02	+0.02	1.14	1.22	4.03	Part
Aug.	2.54	2.36	2.58	2.34	−0.26	−275	2019	1744	−193	1735	− 9	4.0	+0.13	− 137	1598	1667	+ 77	+0.07	3.87	−0.13	1.29	1.48	3.82	Min.
Sept.	2.28	2.19	2.26	2.17	−0.25	−264	1981	1717	−130	1614	−103	4.0	+0.06	− 63	1551	1667	+ 50	+0.05	3.94	−0.06	1.68	1.75	3.92	Min.
Oct.	2.03	1.87	2.17	2.17	−0.28	−296	1981	1685	− 49	1668	− 17	4.0	+0.01	− 11	1657	1667	+ 18	+0.02	3.99	−0.01	1.82	1.88	4.05	Min.
Nov.	1.75	1.63	2.08	1.99	−0.15	−159	1941	1782	+106	1791	+ 9	4.0	−0.11	+ 116	1907	1907	−125	−0.11	4.01	+0.01	1.93	1.96	3.95	Part
Dec.	1.60	1.56	1.90	1.82	−0.20	−211	1902	1691	+122	1904	+213	3.9	−0.10	+ 106	2010	2010	−319	−0.27	3.90	0.00	2.00	1.94	3.76	Part

1895																							
Jan.	1.40	1.23	1.76	1.69	−0.28	−296	1875	1579	− 44	1647	+ 68	3.8	+0.07	− 74	1573	1667	− 88	−0.08	3.63	−0.17	1.87	2.04	3.73	Min.
Feb.	1.12	1.00	1.34	1.00	−0.12	−127	1728	1601	+ 64	1643	+ 42	3.7	+0.15	− 159	1484	1667	− 66	−0.06	3.55	−0.15	2.21	2.37	3.37	Min.
Mar.	1.00	1.01	0.96	0.92	+0.14	+148	1712	1860	+338	1939	+ 79	3.7	+0.31	− 328	1611	1667	+193	+0.18	3.49	−0.21	2.53	2.59	3.51	Min.
April	1.14	1.26	1.02	1.13	+0.23	+243	1756	1999	+179	2039	+ 40	3.8	+0.23	− 243	1796	1796	+203	+0.17	3.67	−0.13	2.65	2.60	3.73	Part
May	1.37	1.48	1.30	1.48	+0.15	+159	1829	1988	− 88	1911	− 77	3.9	+0.16	− 169	1742	1742	+246	+0.21	3.84	−0.06	2.54	2.53	4.01	Part
June	1.52	1.57	1.53	1.58	0.00	0	1851	1851	−129	1859	+ 8	4.0	−0.05	+ 53	1912	1912	− 61	−0.05	4.05	+0.05	2.52	2.48	4.06	Part
July	1.52	1.46	1.57	1.56	−0.10	−106	1846	1740	−186	1665	− 75	4.0	0.00	0	1665	1667	+ 73	+0.07	4.00	0.00	2.43	2.50	4.06	Min.
Aug.	1.42	1.38	1.49	1.42	−0.09	− 95	1817	1722	−183	1557	−165	4.0	−0.07	+ 74	1631	1667	+ 55	+0.05	4.07	+0.07	2.58	2.64	4.06	Min.
Sept.	1.33	1.28	1.43	1.44	−0.29	−307	1821	1514	−130	1592	+ 78	4.0	−0.12	+ 127	1719	1719	−205	−0.17	4.12	+0.12	2.69	2.66	4.10	Part
Oct.	1.04	0.80	1.32	1.20	−0.29	−307	1771	1464	− 49	1465	+ 1	4.0	+0.05	− 53	1412	1667	−203	−0.19	3.95	−0.05	2.63	2.72	3.92	Min.
Nov.	0.75	0.70	0.96	0.71	+0.03	+ 32	1670	1702	+106	1570	−132	4.0	+0.14	− 148	1422	1667	+ 35	+0.03	3.76	−0.24	2.80	2.88	3.59	Min.
Dec.	0.78	0.86	0.84	0.97	+0.13	+137	1723	1860	+122	1824	− 36	3.9	+0.01	− 11	1813	1813	+ 47	+0.04	3.79	−0.11	2.95	2.87	3.84	Part
1896																								
Jan.	0.91	0.96	1.04	1.12	+0.01	+ 11	1754	1765	− 44	1816	+ 51	3.8	−0.13	+ 137	1953	1953	−188	−0.16	3.83	+0.03	2.79	2.69	3.81	Part
Feb.	0.92	0.88	1.08	1.05	−0.06	− 63	1739	1676	+ 64	1829	+153	3.7	+0.03	− 32	1797	1797	−121	−0.10	3.67	−0.03	2.59	2.64	3.69	Part
Mar.	0.86	0.83	0.87	0.69	+0.20	+211	1666	1877	+338	2014	+137	3.7	+0.23	− 243	1771	1771	+106	+0.09	3.57	−0.13	2.70	2.70	3.39	Part
April	1.06	1.28	0.96	1.22	+0.41	+434	1775	2209	+179	2056	−153	3.8	+0.24	− 254	1802	1802	+407	+0.34	3.66	−0.14	2.70	2.63	3.85	Part
May	1.47	1.66	1.44	1.67	+0.33	+349	1870	2219	− 88	2121	− 98	3.9	0.00	0	2121	2121	+ 98	+0.08	4.00	+0.10	2.56	2.48	4.15	Part
June	1.80	1.93	1.68	1.68	+0.07	+ 74	1872	1946	−129	2090	+144	4.0	−0.08	+ 85	2175	2175	−229	−0.19	4.08	+0.08	2.40	2.26	3.94	Part
July	1.87	1.81	1.77	1.86	+0.05	+ 53	1911	1964	−186	1760	−204	4.0	+0.11	− 116	1644	1667	+297	+0.28	3.89	−0.11	2.12	2.16	4.02	Min.
Aug.	1.92	2.02	1.98	2.09	−0.06	− 63	1962	1899	−183	1781	−118	4.0	−0.17	+ 180	1961	1961	− 62	−0.05	4.17	+0.17	2.19	2.22	4.31	Part
Sept.	1.86	1.70	1.88	1.67	−0.28	−296	1870	1574	−130	1769	+195	4.0	−0.12	+ 127	1896	1896	−322	−0.27	4.12	+0.12	2.24	2.28	3.95	Part
Oct.	1.58	1.46	1.54	1.41	−0.30	−317	1815	1498	− 49	1525	+ 27	4.0	+0.15	− 159	1366	1667	−169	−0.16	3.85	−0.15	2.31	2.29	3.70	Min.
Nov.	1.28	1.09	1.42	1.44	−0.18	−190	1821	1631	+106	1604	− 27	4.0	+0.21	− 222	1382	1667	− 36	−0.03	3.69	−0.31	2.27	2.30	3.74	Min.
Dec.	1.10	1.12	1.34	1.23	0.00	0	1776	1776	+122	1753	− 23	3.9	+0.14	− 148	1605	1667	+109	+1.10	3.66	−0.24	2.32	2.34	3.57	Min.
1897																								
Jan.	1.10	1.09	1.41	1.59	+0.09	+ 95	1854	1949	− 44	1732	−217	3.8	−0.06	+ 63	1795	1795	+154	+0.13	3.76	−0.04	2.35	2.44	4.03	Part
Feb.	1.19	1.29	1.37	1.15	+0.29	+307	1760	2067	+ 64	2013	− 54	3.7	−0.19	+ 201	2214	2214	−147	−0.12	3.89	+0.19	2.52	2.44	3.59	Part
Mar.	1.48	1.66	1.40	1.66	+0.46	+486	1867	2353	+338	2405	+ 52	3.7	+0.03	− 32	2373	2366	− 13	−0.01	3.77	+0.07	2.37	2.10	3.76	Open
April	1.94	2.21	1.92	2.18	+0.44	+465	1983	2448	+179	2532	+ 84	3.8	+0.14	− 148	2384	2364	+ 84	+0.07	3.76	−0.04	1.84	1.64	3.82	Open
May	2.38	2.54	2.39	2.60	+0.21	+222	2080	2302	− 88	2360	+ 58	3.9	+0.17	− 180	2180	2180	+122	+0.10	3.83	−0.07	1.44	1.38	3.98	Part
June	2.59	2.64	2.60	2.59	+0.05	+ 53	2076	2129	−129	2173	+ 44	4.0	+0.07	− 74	2099	2099	+ 30	+0.03	3.93	−0.07	1.33	1.36	3.95	Part
July	2.64	2.63	2.58	2.57	−0.09	− 95	2072	1977	−186	1943	− 34	4.0	+0.04	− 42	1901	1901	+ 76	+0.06	3.96	−0.04	1.38	1.44	4.01	Part
Aug.	2.55	2.47	2.51	2.45	−0.22	−233	2045	1812	−183	1794	− 18	4.0	−0.02	+ 21	1815	1815	− 3	0.00	4.02	+0.02	1.51	1.63	4.08	Part
Sept.	2.33	2.19	2.27	2.09	−0.39	−412	1963	1551	−130	1682	+131	4.0	−0.02	+ 21	1703	1703	−152	−0.13	4.02	+0.02	1.75	1.88	3.97	Part
Oct.	1.94	1.70	1.87	1.65	−0.30	−317	1865	1548	− 49	1502	− 46	4.0	+0.11	− 116	1386	1667	−119	−0.11	3.89	−0.11	2.02	2.06	3.71	Min.
Nov.	1.64	1.57	1.67	1.69	−0.08	− 85	1874	1789	+106	1654	−135	4.0	+0.12	− 127	1527	1667	+122	+0.12	3.78	−0.22	2.11	2.13	3.82	Min.
Dec.	1.56	1.54	1.75	1.81	0.00	0	1900	1900	+122	1911	+ 11	3.9	−0.10	+ 106	2017	2017	−117	−0.10	3.90	0.00	2.15	2.10	3.91	Part
1898																								
Jan.	1.56	1.59	1.74	1.68	+0.13	+137	1872	2009	− 44	1856	−153	3.8	−0.10	+ 106	1962	1962	+ 47	+0.04	3.80	0.00	2.06	2.14	3.82	Part
Feb.	1.69	1.79	1.62	1.57	+0.23	+243	1849	2092	+ 64	2073	− 19	3.7	−0.14	+ 148	2221	2221	−129	−0.11	3.84	+0.14	2.22	2.10	3.67	Part
Mar.	1.92	2.05	1.76	1.95	+0.42	+444	1930	2374	+338	2430	+ 56	3.7	+0.07	− 74	2356	2356	+ 18	+0.02	3.73	+0.03	1.97	1.74	3.69	Open
April	2.34	2.63	2.25	2.55	+0.36	+381	2067	2448	+179	2553	+105	3.8	+0.15	− 159	2394	2362	+ 86	+0.07	3.75	−0.05	1.50	1.35	3.90	Open
May	2.70	2.78	2.62	2.68	+0.10	+106	2098	2204	− 88	2360	+156	3.9	+0.18	− 190	2170	2170	+ 34	+0.03	3.82	−0.08	1.20	1.18	3.86	Part
June	2.80	2.81	2.70	2.72	−0.10	−106	2107	2001	−129	2075	+ 74	4.0	+0.15	− 159	1916	1916	+ 85	+0.07	3.85	−0.15	1.15	1.23	3.95	Part

.—The flow of 1000 c.f.s. through the Erie Canal and that of 1100 c.f.s. through the Welland Canal have been omitted.

TABLE 33.—Continued. REGULATION OF LAKE ERIE BETWEEN STAGES 573.7 AND 574.7.

DATE	WATER LEVELS OF LAKE ERIE. CLEVELAND, O. First of Month	CLEVELAND, O. Mean of Month	BUFFALO, N.Y. First of Month	BUFFALO, N.Y. Mean of Month	STORAGE IN LAKE ERIE. Foot Depth	STORAGE IN LAKE ERIE. 100 c.f.s.	OUTFLOW THROUGH NIAGARA RIVER, 100 c.f.s. a	TOTAL SUPPLY TO LAKE ERIE, 100 c.f.s. a	EXPECTED CHANGE IN TOTAL SUPPLY OVER PRECEDING MONTH, 100 c.f.s.	EXPECTED TOTAL SUPPLY FOR MONTH, 100 c.f.s.	EXPECTED TOTAL SUPPLY MINUS TOTAL SUPPLY, 100 c.f.s.	REGULATED LAKE LEVEL DESIRED, BUFFALO, N.Y. First of Month.	CHANGE IN STAGE REQUIRED BY LAST OF MONTH Foot Depth.	CHANGE IN OUTFLOW TO GIVE CHANGE IN PRECEDING COLUMN, 100 c.f.s.	EXPECTED REGULATED OUTFLOW FOR MONTH, 100 c.f.s.	REGULATED OUTFLOW FOR FIRST OF MONTH, 100 c.f.s.	REGULATED STORAGE IN LAKE ERIE. 100 c.f.s.	REGULATED STORAGE IN LAKE ERIE. Foot Depth	REGULATED LAKE LEVEL, BUFFALO, N.Y. First of Month.	REGULATED LEVEL MINUS REGULATED LEVEL DESIRED, First of Month.	REGULATED LAKE LEVEL MINUS ACTUAL LAKE LEVEL, BUFFALO, N.Y. First of Month	REGULATED LAKE LEVEL MINUS ACTUAL LAKE LEVEL, BUFFALO, N.Y. Mean of Month	REGULATED LAKE LEVEL, BUFFALO, N.Y. Mean of Month.	SLUICE GATES.
1898																								
July	572.70	572.59	572.61	572.50	−0.21	−222	2056	1834	−186	1815	− 19	574.0	+0.08	− 85	1730	1730	+104	+0.09	573.92	−0.08	1.31	1.42	573.92	Part
Aug.	2.49	2.39	2.48	2.46	−0.29	−307	2047	1740	−183	1651	− 89	4.0	−0.01	+ 11	1662	1667	− 73	−0.07	4.01	+0.01	1.53	1.67	4.13	Min.
Sept.	2.20	2.01	2.27	2.08	−0.29	−307	1960	1653	−130	1610	− 43	4.0	−0.08	+ 85	1695	1695	− 42	−0.04	4.08	+0.08	1.81	1.92	4.00	Part
Oct.	1.91	1.81	2.00	1.91	−0.16	−169	1922	1753	− 49	1604	−149	4.0	−0.04	+ 42	1646	1667	+ 86	+0.08	4.04	+0.04	2.04	2.10	4.01	Min.
Nov.	1.75	1.69	1.96	2.01	−0.15	−159	1944	1785	+106	1859	− 26	4.0	−0.22	+ 233	2092	2092	−307	−0.26	4.12	+0.12	2.16	1.99	4.00	Part
Dec.	1.60	1.52	2.04	2.07	0.00	0	1957	1957	+122	1907	− 50	3.9	−0.06	+ 63	1970	1970	− 13	−0.01	3.86	−0.04	1.82	1.80	3.87	Part
1899																								
Jan.	1.60	1.67	2.06	2.05	−0.04	− 42	1953	1911	− 44	1913	+ 2	3.8	−0.15	+ 159	2072	2072	−161	−0.14	3.85	+0.05	1.79	1.84	3.89	Part
Feb.	1.56	1.46	1.82	1.59	+0.08	+ 85	1854	1939	+ 64	1975	+ 36	3.7	−0.01	+ 11	1986	1986	− 47	−0.04	3.71	+0.01	1.89	1.92	3.51	Part
Mar.	1.64	1.83	1.72	1.85	+0.34	+360	1908	2268	+338	2277	+ 9	3.7	+0.13	− 137	2140	2140	+128	+0.11	3.67	−0.03	1.95	1.90	3.75	Part
April	1.98	2.13	1.94	2.04	+0.30	+317	1952	2269	+179	2447	+178	3.8	+0.12	− 127	2320	2320	− 51	−0.04	3.78	−0.02	1.84	1.70	3.74	Part
May	2.28	2.44	2.18	2.32	+0.22	+233	2015	2248	− 88	2181	− 67	3.9	+0.26	− 275	1906	1906	+342	+0.29	3.74	−0.16	1.56	1.58	3.90	Part
June	2.50	2.56	2.43	2.51	−0.08	− 85	2058	1973	−129	2119	+146	4.0	−0.03	+ 32	2151	2151	−178	−0.15	4.03	+0.03	1.61	1.50	4.01	Part
July	2.42	2.28	2.48	2.45	−0.24	−254	2045	1791	−186	1787	− 4	4.0	+0.12	− 127	1660	1667	+124	+0.12	3.88	−0.12	1.40	1.56	4.01	Min.
Aug.	2.18	2.09	2.27	2.09	−0.21	−222	1962	1740	−183	1608	−132	4.0	0.00	0	1608	1667	+ 73	+0.07	4.00	0.00	1.73	1.90	3.99	Min
Sept.	1.97	1.85	2.00	1.90	−0.24	−254	1920	1666	−130	1610	− 56	4.0	−0.07	+ 74	1684	1684	− 18	−0.02	4.07	+0.07	2.07	2.22	4.12	Part
Oct.	1.73	1.61	1.69	1.48	−0.11	−116	1829	1713	− 49	1617	− 96	4.0	−0.05	+ 53	1670	1670	+ 43	+0.04	4.05	+0.05	2.36	2.46	3.94	Part
Nov.	1.62	1.62	1.52	1.55	−0.14	−148	1845	1697	+106	1819	+122	4.0	−0.19	+ 201	2020	2020	−323	−0.27	4.09	+0.09	2.57	2.32	3.87	Part
Dec.	1.48	1.34	1.76	1.96	−0.13	−137	1933	1796	+122	1819	+ 23	3.9	−0.02	+ 21	1840	1840	− 44	−0.04	3.82	−0.08	2.06	2.01	3.97	Part
1900																								
Jan.	1.35	1.36	1.82	1.67	+0.11	+116	1870	1986	− 44	1752	−234	3.8	−0.08	+ 85	1837	1837	+149	+0.13	3.78	−0.02	1.96	2.12	3.79	Part
Feb.	1.46	1.57	1.64	1.61	+0.28	+296	1857	2153	+ 64	2050	−103	3.7	−0.21	+ 222	2272	2272	−119	−0.10	3.91	+0.21	2.27	2.18	3.79	Part
Mar.	1.74	1.92	1.72	1.82	+0.34	+360	1902	2262	+338	2491	+229	3.7	−0.01	+ 11	2502	2377	−115	−0.10	3.81	+0.11	2.09	1.90	3.72	Open
April	2.08	2.23	1.99	2.16	+0.23	+243	1978	2221	+179	2441	+220	3.8	+0.19	− 201	2240	2240	− 19	−0.02	3.71	−0.09	1.72	1.58	3.74	Part
May	2.31	2.39	2.24	2.33	+0.12	+127	2017	2144	− 88	2133	− 11	3.9	+0.31	− 328	1805	1805	+339	+0.28	3.69	−0.21	1.45	1.52	3.85	Part
June	2.43	2.47	2.37	2.41	−0.03	− 32	2035	2003	−129	2015	+ 12	4.0	+0.03	− 32	1983	1983	+ 20	+0.02	3.97	−0.03	1.60	1.58	3.99	Part
July	2.40	2.34	2.42	2.43	−0.08	− 85	2040	1955	−186	1817	−138	4.0	+0.01	− 11	1806	1806	+149	+0.13	3.99	−0.01	1.57	1.66	4.09	Part
Aug.	2.32	2.31	2.37	2.31	−0.17	−180	2013	1833	−183	1772	− 61	4.0	−0.12	+ 127	1899	1899	− 66	−0.06	4.12	+0.12	1.75	1.81	4.12	Part
Sept.	2.15	1.99	2.19	2.07	−0.28	−296	1957	1661	−130	1730	+ 42	4.0	−0.06	+ 63	1766	1766	−105	−0.09	4.06	+0.06	1.87	1.98	4.05	Part
Oct.	1.87	1.75	1.88	1.68	−0.25	−264	1872	1608	− 49	1612	+ 4	4.0	+0.03	− 32	1580	1667	− 59	−0.06	3.97	−0.03	2.09	2.12	3.80	Min.
Nov.	1.62	1.49	1.76	1.84	−0.15	−159	1906	1747	+106	1714	− 33	4.0	−0.01	+ 11	1725	1725	+ 22	+0.02	3.91	−0.09	2.15	2.14	3.98	Part
Dec.	1.47	1.45	1.80	1.77	−0.07	− 74	1891	1817	+122	1869	+ 52	3.9	−0.13	+ 137	2006	2006	−189	−0.16	3.93	+0.03	2.13	2.11	3.88	Part

1901																							
Jan.	1.40	1.35	1.68	1.60	−0.22	−233	1855	1622	− 44	1773	+151	3.8	−0.07	+ 74	1847	1847	−225	−0.19	3.77	−0.03	2.09	2.18	3.78	Part
Feb.	1.18	1.00	1.32	1.03	−0.24	−254	1734	1480	+ 64	1686	+206	3.7	+0.12	− 127	1559	1667	−187	−0.18	3.58	−0.12	2.26	2.37	3.40	Min
Mar.	0.94	0.88	0.92	0.82	+0.14	+148	1691	1839	+338	1818	− 21	3.7	+0.46	− 423	1395	1667	+172	+0.16	3.40	−0.30	2.48	2.55	3.37	Min.
April	1.08	1.29	0.94	1.05	+0.22	+323	1739	1972	+179	2018	+ 46	3.8	+0.34	− 360	1658	1667	+305	+0.29	3.56	−0.24	2.62	2.68	3.73	Min.
May	1.30	1.31	1.11	1.17	+0.22	+233	1765	1998	− 88	1884	−114	3.9	+0.15	− 159	1725	1725	+273	+0.23	3.85	−0.05	2.74	2.70	3.87	Part.
June	1.52	1.72	1.43	1.69	+0.30	+317	1875	2192	−129	1869	−323	4.0	−0.08	+ 85	1954	1954	+238	+0.20	4.08	+0.08	2.65	2.58	4.27	Part
July	1.82	1.91	1.78	1.88	+0.02	+ 21	1915	1936	−186	2006	+ 70	4.0	−0.28	+ 296	2302	2302	−366	−0.31	4.28	+0.28	2.50	2.34	4.22	Part
Aug.	1.84	1.78	1.79	1.70	−0.10	−106	1876	1770	−183	1753	− 17	4.0	+0.03	− 32	1721	1721	+ 49	+0.04	3.97	−0.03	2.18	2.24	3.94	Part
Sept.	1.74	1.71	1.72	1.75	−0.22	−233	1887	1654	−130	1640	− 14	4.0	−0.01	+ 11	1651	1667	− 13	−0.01	4.01	+0.01	2.29	2.32	4.07	Min.
Oct.	1.52	1.33	1.64	1.53	−0.28	−296	1840	1544	− 49	1605	+ 61	4.0	0.00	0	1605	1667	−123	−0.12	4.00	0.00	2.36	2.39	3.92	Min.
Nov.	1.24	1.16	1.46	1.39	−0.06	− 63	1810	1747	+106	1650	− 97	4.0	+0.02	− 21	1629	1667	+ 80	+0.08	3.88	−0.12	2.42	2.50	3.89	Min.
Dec.	1.18	1.19	1.38	1.37	−0.04	− 42	1806	1764	+122	1869	+105	3.9	−0.16	+ 169	2038	2038	−274	−0.23	3.96	+0.06	2.58	2.46	3.83	Part
1902																								
Jan.	1.14	1.08	1.39	1.41	−0.28	−296	1815	1519	− 44	1720	+201	3.8	−0.03	+ 32	1752	1752	−233	−0.20	3.73	−0.07	2.34	2.38	3.79	Part
Feb.	0.86	0.63	1.10	0.79	−0.08	− 85	1685	1600	+ 64	1582	− 17	3.7	+0.17	− 180	1403	1667	− 67	−0.06	3.53	−0.17	2.43	2.52	3.31	Min.
Mar.	0.78	0.94	0.87	0.95	+0.44	+465	1718	2183	+338	1938	−245	3.7	+0.33	− 349	1589	1667	+516	+0.49	3.47	−0.23	2.60	2.67	3.62	Min.
April	1.22	1.49	1.22	1.50	+0.46	+486	1834	2320	+179	2362	+ 42	3.8	−0.06	+ 63	2425	2416	− 96	−0.08	3.96	+0.16	2.74	2.50	4.00	Open
May	1.68	1.86	1.62	1.74	+0.31	+328	1885	2213	− 88	2232	+ 19	3.9	+0.12	− 127	2105	2105	+108	+0.09	3.88	−0.02	2.26	2.16	3.90	Part
June	1.99	2.12	1.90	2.05	+0.44	+465	1954	2419	−129	2084	−335	4.0	+0.03	− 32	2052	2052	+367	+0.31	3.97	−0.03	2.07	1.98	4.03	Part
July	2.43	2.74	2.39	2.73	+0.30	+317	2109	2426	−186	2233	−193	4.0	−0.28	+ 296	2529	2500	− 74	−0.06	4.28	+0.28	1.89	1.72	4.45	Open
Aug.	2.73	2.72	2.68	2.64	−0.18	−190	2089	1899	−183	2243	+344	4.0	−0.22	+ 233	2476	2476	−577	−0.48	4.22	+0.22	1.54	1.40	4.04	Part
Sept.	2.55	2.38	2.47	2.30	−0.21	−222	2010	1788	−130	1769	− 19	4.0	+0.26	− 275	1494	1667	+121	+0.11	3.74	−0.26	1.27	1.39	3.69	Min.
Oct.	2.34	2.29	2.34	2.39	−0.18	−190	2032	1842	− 49	1739	−103	4.0	+0.15	− 159	1580	1667	+175	+0.17	3.85	−0.15	1.51	1.64	4.03	Min.
Nov.	2.16	2.02	2.26	2.14	−0.24	−254	1974	1720	+106	1948	+228	4.0	−0.12	+ 127	2075	2075	−355	−0.30	4.02	+0.02	1.76	1.66	3.80	Part
Dec	1.92	1.82	2.17	2.20	−0.15	−159	1988	1829	+122	1842	+ 13	3.9	+0.08	− 85	1757	1757	+ 72	+0.06	3.72	−0.18	1.55	1.62	3.82	Part
1903																								
Jan.	1.77	1.72	2.10	1.99	−0.06	− 63	1940	1877	− 44	1785	− 92	3.8	−0.08	+ 85	1870	1870	+ 7	+0.01	3.78	−0.02	1.68	1.82	3.81	Part
Feb.	1.71	1.70	1.84	1.70	+0.28	+296	1876	2172	+ 64	1941	−231	3.7	−0.09	+ 95	2036	2036	+136	+0.11	3.79	+0.09	1.95	1.96	3.66	Part
Mar.	1.99	2.28	1.92	2.13	+0.67	+708	1971	2679	+338	2510	−169	3.7	−0.10	+ 106	2616	2400	+279	+0.23	3.90	+0.20	1.98	1.82	3.95	Open
April	2.66	3.05	2.48	2.83	+0.41	+434	2133	2567	+179	2858	+291	3.8	−0.23	+ 243	3101	2460	+107	+0.09	4.13	+0.33	1.65	1.52	4.35	Open
May	3.07	3.09	2.84	2.85	0.00	0	2138	2138	− 88	2479	+341	3.9	−0.22	+ 233	2712	2484	−346	−0.29	4.22	+0.32	1.38	1.20	4.05	Open
June	3.07	3.05	2.90	2.95	−0.05	− 53	2163	2110	−129	2009	−101	4.0	+0.07	− 74	1935	1935	+175	+0.15	3.93	−0.07	1.03	1.07	4.02	Part
July	3.02	2.98	2.97	2.99	−0.15	−159	2173	2014	−186	1924	−90	4.0	−0.08	+ 85	2009	2009	+ 5	0.00	4.08	+0.08	1.11	1.18	4.17	Part
Aug.	2.87	2.76	2.82	2.64	−0.19	−201	2089	1888	−183	1831	− 57	4.0	−0.08	+ 85	1916	1916	− 28	−0.02	4.08	+0.08	1.26	1.36	4.00	Part
Sept.	2.68	2.59	2.60	2.55	−0.26	−275	2067	1792	−130	1758	− 34	4.0	−0.06	+ 63	1821	1821	− 29	−0.02	4.06	+0.06	1.46	1.52	4.07	Part
Oct.	2.42	2.25	2.46	2.36	−0.41	−434	2024	1590	− 49	1743	+153	4.0	−0.04	+ 42	1785	1785	−195	−0.16	4.04	+0.04	1.58	1.64	4.00	Part
Nov.	2.01	1.77	2.18	2.01	−0.47	−497	1945	1448	+106	1696	+248	4.0	+0.02	− 21	1675	1675	−227	−0.19	3.88	−0.12	1.70	1.68	3.69	Part
Dec.	1.54	1.31	2.02	2.02	−0.29	−307	1947	1640	+122	1570	− 70	3.9	+0.11	− 116	1454	1667	− 27	−0.03	3.69	−0.21	1.69	1.90	3.92	Min.
1904																								
Jan.	1.25	1.19	1.54	1.06	−0.01	− 11	1741	1730	− 44	1596	−134	3.8	+0.04	− 42	1554	1667	+ 63	+0.06	3.66	−0.14	2.12	2.33	3.39	Min.
Feb.	1.24	1.28	1.18	1.30	+0.33	+349	1792	2141	+ 64	1794	−347	3.7	−0.02	+ 21	1816	1816	+325	+0.27	3.72	+0.02	2.54	2.48	3.78	Part
Mar.	1.57	1.86	1.58	1.86	+0.81	+857	1910	2767	+338	2479	−288	3.7	−0.19	+ 201	2680	2423	+344	+0.29	3.99	+0.29	2.41	2.16	4.02	Open
April	2.38	2.91	2.38	2.89	+0.66	+698	2149	2847	+179	2946	+ 99	3.8	−0.38	+ 402	3348	2500	+347	+0.29	4.28	+0.48	1.90	1.70	4.59	Open
May	3.04	3.17	3.06	3.23	+0.20	+211	2231	2442	− 88	2759	+317	3.9	−0.57	+ 603	3362	2579	−137	−0.12	4.57	+0.67	1.51	1.30	4.53	Open
June	3.24	3.32	3.36	3.49	+0.12	+127	2296	2423	−129	2313	−110	4.0	−0.45	+ 476	2789	2546	−123	−0.10	4.45	+0.45	1.09	1.00	4.49	Open

a.—The flow of 1000 c.f.s. through the Erie Canal and that of 1100 c.f.s. through the Welland Canal have been omitted.

TABLE 33.—Continued. REGULATION OF LAKE ERIE BETWEEN STAGES 573.7 AND 574.7.

DATE	WATER LEVELS OF LAKE ERIE. CLEVELAND, O. First of Month	CLEVELAND, O. Mean of Month	BUFFALO, N.Y. First of Month	BUFFALO, N.Y. Mean of Month	STORAGE IN LAKE ERIE Foot Depth	STORAGE IN LAKE ERIE 100 c.f.s.	OUTFLOW THROUGH NIAGARA RIVER, 100 c.f.s. *a*	TOTAL SUPPLY TO LAKE ERIE, 100 c.f.s. *a*	EXPECTED CHANGE IN TOTAL SUPPLY OVER PRECEDING MONTH, 100 c.f.s.	EXPECTED TOTAL SUPPLY FOR MONTH, 100 c.f.s.	EXPECTED TOTAL SUPPLY MINUS TOTAL SUPPLY, 100 c.f.s.	REGULATED LAKE LEVEL DESIRED, BUFFALO, N.Y. First of Month.	CHANGE IN STAGE REQUIRED BY LAST OF MONTH Foot Depth.	CHANGE IN OUTFLOW TO GIVE CHANGE IN PRECEDING COLUMN, 100 c.f.s.	EXPECTED REGULATED OUTFLOW FOR MONTH, 100 c.f.s.	REGULATED OUTFLOW FOR FIRST OF MONTH, 100 c.f.s.	REGULATED STORAGE IN LAKE ERIE. 100 c.f.s.	REGULATED STORAGE IN LAKE ERIE. Foot Depth	REGULATED LAKE LEVEL, BUFFALO, N.Y. First of Month.	REGULATED LEVEL MINUS REGULATED LEVEL DESIRED, First of Month.	REGULATED LAKE LEVEL MINUS ACTUAL LAKE LEVEL, BUFFALO, N.Y. First of Month	REGULATED LAKE LEVEL MINUS ACTUAL LAKE LEVEL, BUFFALO, N.Y. Mean of Month	REGULATED LAKE LEVEL, BUFFALO, N.Y. Mean of Month.	SLUICE GATES.
1904																								
July	573.36	573.41	573.45	573.41	−0.10	−106	2275	2169	−186	2237	+ 68	574.0	−0.35	+ 370	2607	2518	−349	−0.29	574.35	+0.35	0.90	0.85	574.26	Open
Aug.	3.26	3.10	3.26	3.12	−0.29	−307	2204	1897	−183	1986	+ 89	4.0	−0.06	+ 63	2049	2049	−152	−0.13	4.06	+0.06	0.80	0.88	4.00	Part
Sept.	2.97	2.84	2.98	2.84	−0.31	−328	2136	1808	−130	1767	− 41	4.0	+0.07	− 74	1693	1693	+115	+0.10	3.93	−0.07	0.95	1.13	3.97	Part
Oct.	2.66	2.49	2.72	2.61	−0.36	−381	2082	1701	− 49	1759	+ 58	4.0	−0.03	+ 32	1791	1791	− 90	−0.08	4.03	+0.03	1.31	1.40	4.01	Part
Nov.	2.30	2.12	2.46	2.31	−0.36	−381	2012	1631	+106	1807	+176	4.0	−0.05	+ 53	1860	1860	−229	−0.19	3.95	−0.05	1.49	1.52	3.83	Part
Dec.	1.94	1.77	2.22	2.13	−0.30	−317	1972	1655	+122	1753	+ 98	3.9	+0.04	− 42	1711	1711	− 56	−0.05	3.76	−0.14	1.54	1.66	3.79	Part
1905																								
Jan.	1.64	1.52	1.94	1.74	−0.22	−233	1885	1652	− 44	1611	− 41	3.8	−0.01	+ 11	1622	1667	− 15	−0.01	3.71	−0.09	1.77	2.00	3.74	Min.
Feb.	1.42	1.31	1.48	1.23	−0.18	−190	1776	1586	+ 64	1716	+130	3.7	0.00	0	1716	1716	−130	−0.11	3.70	0.00	2.22	2.26	3.49	Part
Mar.	1.24	1.18	1.28	1.32	+0.26	+275	1795	2070	+338	1924	−146	3.7	+0.21	− 222	1702	1702	+368	+0.31	3.59	−0.11	2.31	2.32	3.64	Part
April	1.50	1.83	1.56	1.79	+0.64	+677	1896	2573	+179	2249	−324	3.8	0.00	0	2249	2249	+324	+0.27	3.90	+0.10	2.34	2.22	4.01	Part
May	2.14	2.46	2.08	2.38	+0.58	+613	2028	2641	− 88	2485	−156	3.9	−0.17	+ 180	2665	2471	+170	+0.14	4.17	+0.27	2.09	1.86	4.24	Open
June	2.72	2.98	2.68	2.97	+0.30	+317	2167	2484	−129	2512	+ 28	4.0	−0.31	+ 328	2840	2508	− 24	−0.02	4.31	+0.31	1.63	1.40	4.37	Open
July	3.02	3.06	3.12	3.28	−0.06	− 63	2243	2180	−186	2298	+118	4.0	−0.29	+ 307	2605	2502	−322	−0.27	4.29	+0.29	1.17	1.01	4.29	Open
Aug.	2.96	2.87	3.17	3.06	−0.21	−222	2188	1966	−183	1997	+ 31	4.0	−0.02	+ 21	2018	2018	− 52	−0.04	4.02	+0.02	0.85	0.94	4.00	Part
Sept.	2.75	2.63	2.96	2.86	−0.28	−296	2140	1844	−130	1836	− 8	4.0	+0.02	− 21	1815	1815	+ 29	+0.02	3.98	−0.02	1.02	1.13	3.99	Part
Oct.	2.47	2.31	2.76	2.65	−0.35	−370	2091	1721	− 49	1795	+ 74	4.0	0.00	0	1795	1795	− 74	−0.06	4.00	0.00	1.24	1.36	4.01	Part
Nov.	2.12	1.93	2.47	2.29	−0.20	−211	2008	1797	+106	1827	+ 30	4.0	−0.04	+ 42	1869	1869	− 72	−0.06	3.94	−0.06	1.47	1.49	3.78	Part
Dec.	1.92	1.92	2.37	2.45	+0.01	+ 11	2045	2056	+122	1919	−137	3.9	−0.08	+ 85	2004	2004	+ 52	+0.04	3.88	−0.02	1.51	1.52	3.97	Part
1906																								
Jan.	1.93	1.94	2.39	2.33	+0.01	+ 11	2017	2028	− 44	2012	− 16	3.8	−0.22	+ 233	2245	2245	−217	−0.18	3.92	+0.12	1.53	1.58	3.91	Part
Feb.	1.94	1.93	2.10	1.88	−0.12	−127	1915	1788	+ 64	2092	+304	3.7	−0.04	+ 42	2134	2134	−346	−0.29	3.74	+0.04	1.64	1.66	3.54	Part
Mar.	1.82	1.71	1.77	1.66	+0.10	+106	1868	1974	+338	2126	+152	3.7	+0.35	− 370	1756	1756	+218	+0.18	3.45	−0.25	1.68	1.72	3.38	Part
April	1.92	2.13	1.86	2.06	+0.34	+360	1956	2316	+179	2153	−163	3.8	+0.27	− 286	1867	1867	+449	+0.38	3.63	−0.17	1.77	1.81	3.87	Part
May	2.26	2.40	2.16	2.27	+0.24	+254	2004	2258	− 88	2228	− 30	3.9	−0.01	+ 11	2239	2239	+ 19	+0.02	4.01	+0.11	1.85	1.75	4.02	Part
June	2.50	2.60	2.38	2.49	+0.12	+127	2054	2181	−129	2129	− 52	4.0	−0.03	+ 32	2161	2161	+ 20	+0.02	4.03	+0.03	1.65	1.59	4.08	Part
July	2.62	2.64	2.52	2.56	+0.02	+ 21	2070	2091	−186	1995	− 96	4.0	−0.05	+ 53	2048	2048	+ 43	+0.04	4.05	+0.05	1.53	1.54	4.10	Part
Aug.	2.64	2.63	2.54	2.51	−0.15	−159	2057	1898	−183	1908	+ 10	4.0	−0.09	+ 95	2003	2003	−105	−0.09	4.09	+0.09	1.55	1.58	4.09	Part
Sept.	2.49	2.35	2.39	2.27	−0.21	−222	2004	1782	−130	1768	− 14	4.0	0.00	0	1768	1768	+ 14	+0.01	4.00	0.00	1.61	1.68	3.95	Part
Oct.	2.28	2.21	2.26	2.25	−0.08	− 85	1999	1914	− 49	1733	−181	4.0	−0.01	+ 11	1744	1744	+170	+0.14	4.01	+0.01	1.75	1.81	4.06	Part
Nov.	2.20	2.18	2.28	2.32	+0.10	+106	2015	2121	+106	2020	−101	4.0	−0.25	+ 264	2284	2284	−163	−0.14	4.15	+0.15	1.87	1.75	4.07	Part
Dec.	2.30	2.42	2.38	2.45	+0.29	+307	2045	2352	+122	2243	−109	3.9	−0.21	+ 222	2465	2429	− 77	−0.06	4.01	+0.11	1.63			Open

1873																								
Jan.	571.21	571.16	571.52	571.41	−0.05	− 53	1814	1761	− 44	1640	−121	573.8	−0.10	+ 106	1746	1746	+ 15	+0.01	573.80	0.00	2.28	2.40	573.81	Part
Feb.	1.16	1.17	1.30	1.20	+0 04	+ 42	1771	1813	+ 64	1825	+ 12	3.7	−0.11	+ 116	1941	1941	−128	−0.11	3.81	+0.11	2.51	2.50	3.70	Part
Mar.	1.20	1.24	1.21	1 22	+0.68	+ 719	1775	2494	+338	2151	−343	3.7	+0.10	− 106	2045	2045	+449	+0.38	3.70	0.00	2.49	2.38	3.60	Part
April	1.88	2.52	1.82	2.43	+0.98	+1036	2040	3076	+179	2673	−403	3.8	−0.18	+ 190	2863	2447	+629	+0.53	4.08	+0.28	2.26	2.06	4.49	Open
May	2 86	3.19	2 76	3.09	+0.37	+ 391	2196	2587	− 88	2988	+401	3.9	−0.61	+ 645	3633	2590	− 3	0.00	4.61	+0.71	1.85	1.65	4.74	Open
June	3.23	3 27	3.16	3.24	+0.03	+ 32	2234	2266	−129	2458	+192	4.0	−0.61	+ 645	3103	2590	−324	−0.27	4.61	+0.61	1.45	1.26	4.50	Open
July	3.26	3 25	3.26	3 29	−0.04	− 42	2246	2204	−186	2080	−124	4.0	−0.34	+ 360	2440	2440	−236	−0.20	4.34	+0.34	1.08	1.00	4.29	Part
Aug.	3.22	3,19	3.22	3.15	−0.23	− 243	2210	1967	−183	2021	+ 54	4.0	−0.14	+ 148	2169	2169	−202	−0.17	4.14	+0.14	0.92	0.96	4.11	Part
Sept.	2 99	2.79	2.98	2.81	−0.35	− 370	2129	1759	−130	1837	+ 78	4.0	+0.03	− 32	1805	1805	− 46	−0.04	3.97	−0.03	0.99	1.12	3.93	Part
Oct.	2 64	2 49	2.69	2.57	−0 25	− 264	2073	1809	− 49	1710	− 99	4.0	+0.07	− 74	1636	1667	+142	+0.13	3.93	−0.07	1.24	1.39	3.96	Min.
Nov.	2 39	2 29	2.52	2.48	+0.09	+ 95	2051	2146	+106	1915	−231	4.0	−0.16	+ 169	2084	2084	+ 62	+0.05	4.06	+0.06	1.54	1.44	3.92	Part
Dec.	2 48	2 66	2.76	3 04	+0.38	+ 402	2185	2587	+122	2268	−319	3.9	−0.31	+ 328	2596	2455	+142	+0.11	4.11	+0.21	1.35			Open
1876																								
Jan.	572 38	572 36	572.70	572 61	+0.26	+ 275	2081	2356	− 44	2173	−183	573.8	−0.10	+ 106	2279	2279	+ 77	+0.06	573.80	0.00	1.10	1.09	573.70	Part
Feb.	2 64	2.92	2 78	2.95	+0 60	+ 634	2162	2796	+ 64	2420	−376	3.7	−0.16	+ 169	2589	2390	+406	+0.34	3.86	+0.16	1.08	1.02	3.97	Open
Mar.	3 24	3 57	3.25	3.55	+0 59	+ 624	2311	2935	+338	3134	+199	3.7	−0.40	+ 423	3557	2479	+456	+0.38	4.20	+0.50	0.95	0.88	4.43	Open
April	3 83	4 09	3.78	4 00	+0.42	+ 444	2425	2869	+179	3114	+245	3.8	−0.68	+ 719	3833	2582	+287	+0.24	4.58	+0.78	0.80	0.73	4.73	Open
May	4 25	4 41	4 16	4.31	+0 21	+ 222	2507	2729	− 88	2781	+ 52	3.9	−0.82	+ 867	3648	2648	+ 81	+0.07	4.82	+0.92	0.66	0.58	4.89	Open
June	4 46	4 52	4.40	4 49	0 00	0	2557	2557	−129	2600	+ 43	4.0	−0.89	+ 941	3541	2667	−110	−0.09	4.89	+0.89	0.49	0.41	4.90	Open
July	4 46	4 41	4 47	4.45	−0 20	− 211	2546	2335	−186	2371	+ 36	4.0	−0.80	+ 846	3217	2642	−307	−0.26	4.80	+0.80	0.33	0.30	4.75	Open
Aug.	4 26	4 11	4 26	4.07	−0 24	− 254	2444	2190	−183	2152	− 38	4.0	−0.54	+ 571	2723	2571	−381	−0.32	4 54	+0.54	0.28	0.24	4.31	Open
Sept.	4 02	3 94	4 02	3 96	−0.34	− 360	2414	2054	−130	2060	+ 6	4.0	−0.22	+ 233	2293	2293	−239	−0.20	4 22	+0.22	0.20	0.25	4.21	Part
Oct.	3 68	3 41	3 72	3 49	−0 23	− 243	2296	2053	− 49	2005	− 48	4.0	−0.02	+ 21	2026	2026	+ 27	+0.02	4 02	+0.02	0.30	0.38	3.87	Part
Nov.	3 45	3 49	3.58	3 68	−0 13	− 137	2344	2207	+106	2159	− 48	4.0	−0.14	+ 148	2307	2307	−100	−0.08	4.04	+0.04	0.46	0.41	4.09	Part
Dec.	3 32	3 15	3.60	3.53	−0 37	− 391	2306	1915	+122	2329	+414	3.9	−0.16	+ 169	2498	2416	−501	−0.42	3.96	+0.06	0.36			Open

a.—The flow of 1000 c.f.s. through the Erie Canal, and that of 1100 c.f.s. through the Welland Canal have been omitted.

TABLE 35. REGULATION OF LAKE ERIE BETWEEN STAGES 572.0 AND 574.5.

DATE	WATER LEVELS OF LAKE ERIE. CLEVELAND, O. First of Month	CLEVELAND, O. Mean of Month	BUFFALO, N.Y. First of Month	BUFFALO, N.Y. Mean of Month	STORAGE IN LAKE ERIE. Foot Depth	STORAGE IN LAKE ERIE. 100 c.f.s.	OUTFLOW THROUGH NIAGARA RIVER, 100 c.f.s. *a*	TOTAL SUPPLY TO LAKE ERIE, 100 c.f.s. *a*	EXPECTED CHANGE IN TOTAL SUPPLY OVER PRECEDING MONTH, 100 c.f.s.	EXPECTED TOTAL SUPPLY FOR MONTH, 100 c.f.s.	EXPECTED TOTAL SUPPLY MINUS TOTAL SUPPLY, 100 c.f.s.	REGULATED LAKE LEVEL DESIRED, BUFFALO, N.Y. First of Month.	CHANGE IN STAGE REQUIRED BY LAST OF MONTH Foot Depth.	CHANGE IN OUTFLOW TO GIVE CHANGE IN PRECEDING COLUMN, 100 c.f.s.	EXPECTED REGULATED OUTFLOW FOR MONTH, 100 c.f.s.	REGULATED OUTFLOW FOR FIRST OF MONTH, 100 c.f.s.	REGULATED STORAGE IN LAKE ERIE. 100 c.f.s.	REGULATED STORAGE IN LAKE ERIE. Foot Depth	REGULATED LAKE LEVEL, BUFFALO, N.Y. First of Month.	REGULATED LEVEL MINUS REGULATED LEVEL DESIRED, First of Month.	REGULATED LAKE LEVEL MINUS ACTUAL LAKE LEVEL, BUFFALO, N.Y. First of Month	REGULATED LAKE LEVEL MINUS ACTUAL LAKE LEVEL, BUFFALO, N.Y. Mean of Month	REGULATED LAKE LEVEL, BUFFALO, N.Y. Mean of Month.	SLUICE GATES.
1876																								
Jan.	572.38	572.36	572.70	572.61	+0.26	+ 275	2081	2356	− 44	2173	−183	572.3	−0.10	+ 106	2279	2010	+346	+0.29	572.30	0.00	−0.40	−0.30	572.31	Open
Feb.	2.64	2.92	2.78	2.95	+0.60	+ 634	2162	2796	+ 64	2420	−376	2.2	−0.39	+ 412	2832	2077	+719	+0.60	2.59	+0.39	−0.19	−0.12	2.83	Open
Mar.	3.24	3.57	3.25	3.55	+0.59	+ 624	2311	2935	+338	3134	+199	2.2	−0.99	+1047	4181	2221	+714	+0.60	3.19	+0.99	−0.06	−0.02	3.53	Open
April	3.83	4.09	3.78	4.00	+0.42	+ 444	2425	2869	+179	3114	+245	2.2	−1.49	+1576	4690	2372	+497	+0.42	3.79	+1.59	+0.01	+0.03	4.03	Open
May	4.25	4.41	4.16	4.31	+0.21	+ 222	2507	2729	− 88	2781	+ 52	2.3	−1.81	+1914	4695	2482	+247	+0.21	4.21	+1.91	+0.05	+0.04	4.35	Open
June	4.46	4.52	4.40	4.49	0.00	0	2557	2557	−129	2600	+ 43	2.4	−1.92	+2030	4630	2538	+ 19	+0.02	4.42	+2.02	+0.02	0.00	4.49	Open
July	4.46	4.41	4.47	4.45	−0.20	− 211	2546	2335	−186	2371	+ 36	2.5	−1.94	+2051	4422	2543	−208	−0.17	4.44	+1.94	−0.03	−0.01	4.44	Open
Aug.	4.26	4.11	4.26	4.07	−0.24	− 254	2444	2190	−183	2152	− 38	2.5	−1.77	+1872	4024	2497	−307	−0.26	4.27	+1.77	+0.01	0.00	4.07	Open
Sept.	4.02	3.94	4.02	3.96	−0.34	− 360	2414	2054	−130	2060	+ 6	2.5	−1.51	+1597	3657	2429	−375	−0.32	4.01	+1.51	−0.01	−0.02	3.94	Open
Oct.	3.68	3.41	3.72	3.49	−0.23	− 243	2296	2053	− 49	2005	− 48	2.5	−1.19	+1258	3263	2346	−293	−0.25	3.69	+1.19	−0.03	−0.08	3.41	Open
Nov.	3.45	3.49	3.58	3.68	−0.13	− 137	2344	2207	+106	2159	− 48	2.5	−1.04	+1100	3259	2283	− 76	−0.06	3.44	+0.94	−0.14	−0.18	3.50	Open
Dec.	3.32	3.15	3.60	3.53	−0.37	− 391	2306	1915	+122	2329	+414	2.4	−1.08	+1142	3471	2268	−353	−0.30	3.38	+0.98	−0.22	−0.20	3.33	Open
1895																								
Jan.	571.40	571.23	571.76	571.69	−0.28	− 296	1875	1579	− 44	1647	+ 68	572.3	−0.10	+ 106	1753	1753	−174	−0.15	572.30	0.00	+0.54	+0.68	572.37	Part
Feb.	1.12	1.00	1.34	1.00	−0.12	− 127	1728	1601	+ 64	1643	+ 42	2.2	+0.05	− 53	1590	1667	− 66	−0.06	2.15	−0.05	+0.81	+0.97	1.97	Min.
Mar.	1.00	1.01	0.96	0.92	+0.14	+ 148	1712	1860	+338	1939	+ 79	2.2	+0.11	− 116	1823	1823	+ 37	+0.03	2.09	−0.11	+1.13	+1.12	2.04	Part
April	1.14	1.26	1.02	1.13	+0.23	+ 243	1756	1999	+179	2039	+ 40	2.2	+0.18	− 190	1849	1849	+150	+0.13	2.12	−0.08	+1.10	+1.02	2.15	Part
May	1.37	1.48	1.30	1.48	+0.15	+ 159	1829	1988	− 88	1911	− 77	2.3	+0.15	− 159	1752	1752	+236	+0.20	2.25	−0.05	+0.95	+0.94	2.42	Part
June	1.52	1.57	1.53	1.58	0.00	0	1851	1851	−129	1859	+ 8	2.4	+0.05	− 53	1806	1806	+ 45	+0.04	2.45	+0.05	+0.92	+0.92	2.50	Part
July	1.52	1.46	1.57	1.56	−0.10	− 106	1846	1740	−186	1665	− 75	2.5	+0.01	+ 11	1654	1667	+ 73	+0.07	2.49	−0.01	+0.92	+1.00	2.56	Min.
Aug.	1.42	1.38	1.49	1.42	−0.09	− 95	1817	1722	−183	1557	−165	2.5	−0.06	+ 63	1620	1667	+ 55	+0.05	2.56	+0.06	+1.07	+1.12	2.54	Min.
Sept.	1.33	1.28	1.43	1.44	−0.29	− 307	1821	1514	−130	1592	+ 78	2.5	−0.11	+ 116	1708	1708	−194	−0.16	2.61	+0.11	+1.18	+1.16	2.60	Part
Oct.	1.04	0.80	1.32	1.20	−0.29	− 307	1771	1464	− 49	1465	+ 1	2.5	+0.05	− 53	1412	1667	−203	−0.19	2.45	−0.05	+1.13	+1.22	2.42	Min.
Nov.	0.75	0.70	0.96	0.71	+0.03	+ 32	1670	1702	+106	1570	−132	2.5	+0.14	− 148	1422	1667	+ 35	+0.03	2.26	−0.24	+1.30	+1.38	2.09	Min.
Dec.	0.78	0.86	0.84	0.97	+0.13	+ 137	1723	1860	+122	1824	− 36	2.4	+0.01	− 11	1813	1813	+ 47	+0.04	2.29	−0.11	+1.45	+1.37	2.34	Part

a.—The flow of 1000 c.f.s. through the Erie Canal and that of 1100 c.f.s. through the Welland Canal have been omitted.

TABLE 36. EFFECT OF REGULATION OF LAKE ERIE.
BETWEEN STAGES 572.0 AND 574.5, ON WATER LEVELS OF LAKE ONTARIO.

DATE	WATER LEVELS OF LAKE ONTARIO AT CHARLOTTE, N.Y.		ACTUAL RISE OR FALL DURING MONTH,	INFLOW FROM NIAGARA RIVER, *a*		CHANGE IN INFLOW TO LAKE ONTARIO THROUGH REGULATION OF LAKE ERIE	EFFECT OF CHANGE OF INFLOW ON LEVEL OF LAKE ONTARIO, FOR MONTH,	EFFECT OF CHANGE OF OUTFLOW THROUGH ST. LAWRENCE RIVER ON LEVEL OF LAKE ONTARIO,	TOTAL EFFECT FROM CHANGE OF INFLOW AND OUTFLOW ON LEVEL OF LAKE ONTARIO,	REGULATED CONDITIONS.		REGULATED LEVEL LESS ACTUAL LEVEL.		WATER LEVELS OF LAKE ONTARIO REGULATED CONDITIONS,
				ACTUAL CONDITIONS,	REGULATED CONDITIONS,					RISE OR FALL DURING MONTH,	STAGE OF LAKE ONTARIO,			
	First of Month	Mean of Month.	In Feet.	100 c.f.s.	100 c.f.s.	100 c.f.s.	In Feet.	In Feet.	In Feet.	In Feet.	First of Month.	First of Month.	Mean of Month.	Mean of Month.
1876														
Jan.	245.28	245.48	+0.52	2081	2049	− 32	−0.035	0.000	−0.035	+0.485	245.280	0.000	−0.018	245.46
Feb.	5.80	6.11	+0.60	2162	2157	− 5	−0.006	+0.011	+0.005	+0.605	5.765	−0.035	−0.032	6.08
Mar.	6.40	6.70	+0.76	2311	2301	− 10	−0.011	+0.010	−0.001	+0.759	6.370	−0.030	−0.030	6.67
April	7.16	7.62	+0.80	2425	2428	+ 3	+0.003	+0.010	+0.013	+0.813	7.129	−0.031	−0.024	7.60
May	7.96	8.30	+0.40	2507	2510	+ 3	+0.003	+0.006	+0.009	+0.409	7.942	−0.018	−0.014	8.29
June	8.36	8.42	+0.07	2557	2541	− 16	−0.017	+0.003	−0.014	+0.056	8.351	−0.009	−0.016	8.40
July	8.43	8.44	−0.20	2546	2520	− 26	−0.028	+0.008	−0.020	−0.220	8.407	−0.023	−0.033	8.41
Aug.	8.23	8.02	−0.55	2444	2462	+ 18	+0.020	+0.014	+0.034	−0.516	8.187	−0.043	−0.026	7.99
Sept.	7.68	7.35	−0.50	2414	2386	− 28	−0.031	+0.003	−0.028	−0.528	7.671	−0.009	−0.023	7.33
Oct.	7.18	7.00	−0.35	2296	2313	+ 17	+0.019	+0.012	+0.031	−0.319	7.143	−0.037	−0.022	6.98
Nov.	6.83	6.66	−0.31	2344	2275	− 69	−0.076	+0.002	−0.074	−0.384	6.824	−0.006	−0.043	6.62
Dec.	6.52	6.39	−0.34	2306	2228	− 78	−0.085	+0.025	−0.060	−0.400	6.440	−0.080	−0.110	6.28
1895														
Jan.	244.54	244.55	−0.07	1875	1733	−142	−0.157	0.000	−0.157	−0.227	244.540	0.000	−0.078	244.47
Feb.	4.47	4.39	−0.07	1728	1667	− 61	−0.068	+0.047	−0.021	−0.091	4.313	−0.157	−0.168	4.22
Mar.	4.40	4.40	+0.17	1712	1827	+115	+0.127	+0.053	+0.180	+0.350	4.222	−0.178	−0.088	4.31
April	4.57	4.74	+0.28	1756	1866	+110	+0.122	−0.001	+0.121	+0.401	4.572	+0.002	+0.062	4.80
May	4.85	4.96	+0.03	1829	1779	− 50	−0.055	−0.037	−0.092	−0.062	4.973	+0.123	+0.077	5.04
June	4.88	4.79	−0.22	1851	1811	− 40	−0.044	−0.009	−0.053	−0.273	4.911	+0.031	+0.004	4.79
July	4.66	4.53	−0.26	1846	1667	−179	−0.198	+0.007	−0.191	−0.451	4.638	−0.022	−0.118	4.41
Aug.	4.40	4.26	−0.25	1817	1667	−150	−0.166	+0.064	−0.102	−0.352	4.187	−0.213	−0.264	4.00
Sept.	4.15	4.04	−0.31	1821	1687	−134	−0.149	+0.091	−0.058	−0.368	3.835	−0.315	−0.344	3.70
Oct.	3.84	3.64	−0.32	1771	1667	−104	−0.116	+0.108	−0.008	−0.328	3.467	−0.373	−0.377	3.26
Nov.	3.52	3.41	−0.06	1670	1667	− 3	−0.003	+0.110	+0.107	+0.047	3.139	−0.381	−0.328	3.08
Dec.	3.46	3.51	+0.18	1723	1818	+ 95	+0.106	+0.079	+0.185	+0.365	3.186	−0.274	−0.182	3.33

a.—The flow of 1000 c.f.s. through the Erie Canal and that of 1100 c.f.s. through the Welland Canal have been omitted.

TABLE 38.

REGULATION OF LAKE SUPERIOR TO COMPENSATE FOR DIVERSION OF 4000 CUBIC FEET PER SECOND THROUGH THE CHICAGO DRAINAGE CANAL.

DATE	WATER LEVELS OF ST. MARYS RIVER AT SAULT STE. MARIE, MICH.			TOTAL SUPPLY TO LAKE SUPERIOR	ASSUMED CONSTANT OUTFLOW THROUGH ST. MARYS RIVER,	TOTAL SUPPLY LESS CONSTANT OUTFLOW,	EFFECT OF CHANGE OF OUTFLOW ON STAGE OF LAKE SUPERIOR FOR MONTH, In Feet.	REGULATED LEVEL LESS ACTUAL LEVEL AT SAULT STE. MARIE, MICH.		WATER LEVELS OF ST. MARYS RIVER AT SAULT STE. MARIE REGULATED CONDITIONS
	Actual Conditions.		Regulated Conditions							
	First of Month.	Mean of Month.	First of Month.	100 c.f.s.	100 c.f.s.	100 c.f.s.		First of Month.	Mean of Month.	Mean of Month.
1888										
May		601.43								
June	601.855	2.28	601.855	2606	697	+1909	+0.543	0.000	+0.019	602.299
July	2.36	2.44	2.398	1553	697	+ 856	+0.243	+0.038	+0.122	2.562
Aug.	2.435	2.43	2.641	1143	697	+ 446	+0.127	+0.206	+0.292	2.722
Sept.	2.39	2.35	2.768	734	697	+ 37	+0.011	+0.378	+0.406	2.756
Oct.	2.345	2.34	2.779	578	697	− 119	−0.034	+0.434	+0.470	2.810
Nov.	2.24	2.14	2.745	90	697	− 607	−0.173	+0.505	+0.554	2.694
Dec.	1.97	1.80	2.572	− 361	697	−1058	−0.301	+0.602	+0.606	2.406
1889										
Jan.	1.66	1.52	2.271	− 196	697	− 893	−0.254	+0.611	+0.626	2.146
Feb.	1.375	1.23	2.017	1	697	− 696	−0.198	+0.642	+0.608	1.838
Mar.	1.245	1.26	1.819	398	697	− 299	−0.085	+0.574	+0.526	1.788
April	1.255	1.25	1.734	1280	697	+ 583	+0.166	+0.479	+0.427	1.677
May	1.525	1.81	1.900	1579	697	+ 882	+0.251	+0.375	+0.313	2.123
June	1.90	1.99	2.151	1343	697	+ 646	+0.184	+0.251	+0.230	2.290
July	2.125	2.26	2.335	1516	697	+ 819	+0.233	+0.210	+0.256	2.516
Aug.	2.265	2.27	2.568	1416	697	+ 719	+0.204	+0.303	+0.405	2.675
Sept.	2.265	2.26	2.772	819	697	+ 122	+0.035	+0.507	+0.564	2.824
Oct.	2.185	2.11	2.807	41	697	− 656	−0.187	+0.622	+0.641	2.751
Nov.	1.96	1.81	2.620	− 257	697	− 954	−0.271	+0.660	+0.694	2.504
Dec.	1.62	1.43	2.349	− 44	697	− 741	−0.211	+0.729	+0.706	2.136
1890										
Jan.	1.455	1.48	2.138	255	697	− 442	−0.126	+0.683	+0.745	2.225
Feb.	1.205	0.93	2.012	− 25	697	− 722	−0.205	+0.807	+0.844	1.774
Mar.	0.925	0.92	1.807	143	697	− 554	−0.158	+0.882	+0.823	1.743
April	0.885	0.85	1.649	894	697	+ 197	+0.056	+0.764	+0.692	1.542
May	1.085	1.32	1.705	1804	697	+1107	+0.315	+0.620	+0.515	1.835
June	1.61	1.90	2.020	2073	697	+1376	+0.391	+0.410	+0.370	2.270
July	2.08	2.26	2.411	1635	697	+ 938	+0.267	+0.331	+0.397	2.657
Aug.	2.215	2.17	2.678	1328	697	+ 631	+0.179	+0.463	+0.602	2.772
Sept.	2.115	2.06	2.857	1000	697	+ 303	+0.086	+0.742	+0.830	2.890
Oct.	2.025	1.99	2.943	408	697	− 289	−0.082	+0.918	+0.930	2.920
Nov.	1.92	1.85	2.861	− 181	697	− 878	−0.250	+0.941	+0.926	2.776
Dec.	1.70	1.55	2.610	− 496	697	−1193	−0.339	+0.910	+0.988	2.538
1891										
Jan.	1.205	0.86	2.271	− 243	697	− 940	−0.267	+1.066	+1.078	1.938
Feb.	0.915	0.97	2.004	323	697	− 374	−0.106	+1.089	+1.046	2.016
Mar.	0.895	0.82	1.898	446	697	− 251	−0.071	+1.003	+0.960	1.780
April	0.91	1.00	1.827	890	697	+ 193	+0.055	+0.917	+0.792	1.792
May	1.215	1.43	1.882	1129	697	+ 432	+0.123	+0.667	+0.634	2.064
June	1.405	1.38	2.005	1119	697	+ 422	+0.120	+0.600	+0.645	2.025
July	1.435	1.49	2.125	1022	697	+ 325	+0.092	+0.690	+0.706	2.196
Aug.	1.495	1.50	2.217	616	697	− 81	−0.023	+0.722	+0.726	2.226
Sept.	1.465	1.43	2.194	789	697	+ 92	+0.026	+0.729	+0.744	2.174
Oct.	1.46	1.49	2.220	665	697	− 32	−0.009	+0.760	+0.768	2.258
Nov.	1.435	1.38	2.211	− 139	697	− 836	−0.238	+0.776	+0.762	2.142
Dec.	1.225	1.07	1.973	3	697	− 694	−0.197	+0.748	+0.760	1.830
1892										
Jan.	1.04	1.01	1.776	144	697	− 553	−0.157	+0.772	+0.780	1.790
Feb.	0.83	0.65	1.619	− 149	697	− 846	−0.241	+0.789	+0.804	1.454
Mar.	0.56	0.47	1.378	308	697	− 389	−0.111	+0.818	+0.768	1.238
April	0.55	0.63	1.267	1122	697	+ 425	+0.121	+0.717	+0.610	1.240
May	0.885	1.14	1.388	1853	697	+1156	+0.329	+0.503	+0.450	1.590
June	1.32	1.50	1.717	1415	697	+ 718	+0.204	+0.397	+0.374	1.874
July	1.57	1.64	1.921	1001	697	+ 304	+0.086	+0.351	+0.356	1.996
Aug.	1.645	1.65	2.007	1037	697	+ 340	+0.097	+0.362	+0.393	2.043
Sept.	1.68	1.71	2.104	675	697	− 22	−0.006	+0.424	+0.434	2.144
Oct.	1.655	1.60	2.098	279	697	− 418	−0.119	+0.443	+0.481	2.081
Nov.	1.46	1.32	1.979	− 83	697	− 780	−0.222	+0.519	+0.548	1.868
Dec.	1.18	1.04	1.757	− 326	697	−1023	−0.291	+0.577	+0.564	1.604
1893										
Jan.	0.915	0.79	1.466	− 110	697	− 807	−0.230	+0.551	+0.548	1.338
Feb.	0.69	0.59	1.236	414	697	− 283	−0.080	+0.546	+0.554	1.144
Mar.	0.595	0.60	1.156	739	697	+ 42	+0.012	+0.561	+0.502	1.102
April	0.725	0.85	1.168	1551	697	+ 854	+0.243	+0.443	+0.360	1.210
May	1.135	1.42	1.411	2372	697	+1675	+0.476	+0.276	+0.239	1.659
June	1.685	1.95	1.887	2132	697	+1435	+0.408	+0.202	+0.224	2.174
July	2.05	2.15	2.295	1387	697	+ 690	+0.196	+0.245	+0.273	2.423
Aug.	2.19	2.23	2.491	739	697	+ 42	+0.012	+0.301		
Sept.	2.165	2.10	2.503							

SESSIONAL PAPER No. 54.

TABLE 39.

REGULATION OF LAKE SUPERIOR TO COMPENSATE FOR DIVERSION OF 14000 CUBIC FEET PER SECOND THROUGH THE CHICAGO DRAINAGE CANAL.

DATE	WATER LEVELS OF ST. MARYS RIVER AT SAULT STE. MARIE, MICH.			TOTAL SUPPLY TO LAKE SUPERIOR	ASSUMED CONSTANT OUTFLOW THROUGH ST. MARYS RIVER,	TOTAL SUPPLY LESS CONSTANT OUTFLOW,	EFFECT OF CHANGE OF OUTFLOW ON STAGE OF LAKE SUPERIOR FOR MONTH, In Feet.	REGULATED LEVEL LESS ACTUAL LEVEL AT SAULT STE. MARIE, MICH.		WATER LEVELS OF ST. MARYS RIVER AT SAULT STE.MARIE REGULATED CONDITIONS
	Actual Conditions.		Regulated Conditions							
	First of Month.	Mean of Month.	First of Month.	100 c.f.s.	100 c.f.s.	100 c.f.s.		First of Month.	Mean of Month.	Mean of Month.
1888										
May		601.43								
June	601.855	2.28	601.855	2606	797	+1809	+0.514	0.000	+0.004	602.284
July	2.36	2.44	2.369	1553	797	+ 756	+0.215	+0.009	+0.079	2.519
Aug.	2.435	2.43	2.584	1143	797	+ 346	+0.098	+0.149	+0.220	2.650
Sept.	2.39	2.35	2.682	734	797	− 63	−0.018	+0.292	+0.306	2.656
Oct.	2.345	2.34	2.664	578	797	− 219	−0.062	+0.319	+0.340	2.680
Nov.	2.24	2.14	2.602	90	797	− 707	−0.201	+0.362	+0.396	2.536
Dec.	1.97	1.80	2.401	− 361	797	−1158	−0.329	+0.431	+0.422	2.222
1889										
Jan.	1.66	1.52	2.072	− 196	797	− 993	−0.282	+0.412	+0.414	1.934
Feb.	1.375	1.23	1.790	1	797	− 796	−0.226	+0.415	+0.367	1.597
Mar.	1.245	1.26	1.564	398	797	− 399	−0.113	+0.319	+0.258	1.518
April	1.255	1.25	1.451	1280	797	+ 483	+0.137	+0.196	+0.130	1.380
May	1.525	1.81	1.588	1579	797	+ 782	+0.222	+0.063	−0.014	1.796
June	1.90	1.99	1.810	1343	797	+ 546	+0.155	−0.090	−0.125	1.865
July	2.125	2.26	1.965	1516	797	+ 719	+0.204	−0.160	−0.128	2.132
Aug.	2.265	2.27	2.169	1416	797	+ 619	+0.176	−0.096	−0.008	2.262
Sept.	2.265	2.26	2.345	819	797	+ 22	+0.006	+0.080	+0.123	2.383
Oct.	2.185	2.11	2.351	41	797	− 756	−0.215	+0.166	+0.171	2.281
Nov.	1.96	1.81	2.136	− 257	797	−1054	−0.300	+0.176	+0.196	2.006
Dec.	1.62	1.43	1.836	− 44	797	− 841	−0.239	+0.216	+0.179	1.609
1890										
Jan.	1.455	1.48	1.597	255	797	− 542	−0.154	+0.142	+0.190	1.670
Feb.	1.205	0.93	1.443	− 25	797	− 822	−0.234	+0.238	+0.261	1.191
Mar.	0.925	0.92	1.209	143	797	− 654	−0.186	+0.284	+0.211	1.131
April	0.885	0.85	1.023	894	797	+ 97	+0.028	+0.138	+0.052	0.902
May	1.085	1.32	1.051	1804	797	+1007	+0.286	−0.034	−0.154	1.166
June	1.61	1.90	1.337	2073	797	+1276	+0.363	−0.273	−0.326	1.574
July	2.08	2.26	1.700	1635	797	+ 838	+0 238	−0.380	−0.328	1.932
Aug.	2.215	2.17	1.938	1328	797	+ 531	+0.151	−0.277	−0.152	2.018
Sept.	2.115	2.06	2.089	1000	797	+ 203	+0.058	−0.026	+0.048	2.108
Oct.	2.025	1.99	2.147	408	797	− 389	−0.111	+0.122	+0.119	2.109
Nov.	1.92	1.85	2.036	− 181	797	− 978	−0.278	+0.116	+0.087	1.937
Dec.	1.70	1.55	1.758	− 496	797	−1293	−0.368	+0.058	+0.122	1.672
1891										
Jan.	1.205	0.86	1.390	− 243	797	−1040	−0 296	+0.185	+0.182	1.042
Feb.	0.915	0.97	1.094	323	797	− 474	−0.135	+0.179	+0.122	1.092
Mar.	0.895	0.82	0.959	446	797	− 351	−0.100	+0.064	+0.006	0.826
April	0.91	1.00	0.859	890	797	+ 93	+0.026	−0.051	−0.190	0.810
May	1.215	1.43	0.885	1129	797	+ 332	+0.094	−0.330	−0.378	1.052
June	1.405	1.38	0.979	1119	797	+ 322	+0.092	−0.426	−0.395	0.985
July	1.435	1.49	1.071	1022	797	+ 225	+0 064	−0.364	−0.362	1.128
Aug.	1.495	1.50	1.135	616	797	− 181	−0.051	−0.360	−0.370	1.130
Sept.	1.465	1.43	1.084	789	797	− 8	−0.002	−0.381	−0.380	1.050
Oct.	1.46	1.49	1.082	665	797	− 132	−0 038	−0.378	−0.384	1.106
Nov.	1.435	1.38	1.044	− 139	797	− 936	−0.266	−0 391	−0 419	0.961
Dec.	1.225	1.07	0.778	3	797	− 794	−0 226	−0.447	−0.472	0.598
1892										
Jan.	1.04	1.01	0.552	144	797	− 653	−0 186	−0.498	−0 481	0.529
Feb.	0.83	0.65	0.366	− 149	797	− 946	−0 269	−0.464	−0 464	0.186
Mar.	0.56	0.47	0.097	308	797	− 489	−0.139	−0.463	−0.528	599.942
April	0.55	0.63	599.958	1122	797	+ 325	+0.092	−0 592	−0.714	9.916
May	0 885	1.14	600.050	1853	797	+1056	+0.300	−0 835	−0 902	600.238
June	1.32	1.50	0 350	1415	797	+ 618	+0.176	−0 970	−1 007	0.493
July	1.57	1.64	0.526	1001	797	+ 204	+0 058	−1 044	−1 052	0.588
Aug.	1.645	1.65	0 584	1037	797	+ 240	+0 068	−1 061	−1 044	0.606
Sept.	1.68	1.71	0.652	675	797	− 122	−0 035	−1.028	−1 033	0.677
Oct.	1.655	1.60	0 617	279	797	− 518	−0 147	−1 038	−1 014	0.586
Nov.	1.46	1.32	0 470	− 83	797	− 880	−0 250	−0.990	−0 975	0.345
Dec.	1.18	1.04	0.220	− 326	797	−1123	−0 319	−0 960	−0 987	0.053
1893										
Jan.	0.915	0 79	599.901	− 110	797	− 907	−0 258	−1 014	−1 030	599.760
Feb.	0.69	0 59	9 643	414	797	− 383	−0 109	−1 047	−1 054	9.536
Mar.	0.595	0 60	9 534	739	797	− 58	−0 016	−1 061	−1 134	9.466
April	0.725	0.85	9.518	1551	797	+ 754	+0 214	−1 207	−1 305	9.545
May	1.135	1.42	9 732	2372	797	+1575	+0 448	−1 403	−1 454	9.966
June	1.685	1.95	600 180	2132	797	+1335	+0 380	−1 505	−1 498	600.452
July	2.05	2.15	0 560	1387	797	+ 590	+0.168	−1 490	−1 476	0.674
Aug.	2.19	2.23	0 728	739	797	− 58	−0 016	−1 462		
Sept.	2.165	2.10	0 712	562	797					

TABLE 40.

EFFECT ON WATER LEVELS OF LAKE MICHIGAN-HURON, OF REGULATION OF LAKE SUPERIOR TO COMPENSATE FOR DIVERSION OF 4000 CUBIC FEET PER SECOND THROUGH CHICAGO DRAINAGE CANAL.

DATE.	WATER LEVELS OF LAKE MICHIGAN-HURON. MEAN, MILWAUKEE AND HARBOR BEACH. First of Month	Mean of Month.	RISE OR FALL IN STAGE OF LAKE MICHIGAN-HURON DURING MONTH, IN FEET.	REGULATED LESS ACTUAL TRANSMITTED SUPPLY, 100 c.f.s.	NET CHANGE IN SUPPLY, *a* 100 c.f.s.	EFFECT OF NET CHANGE IN SUPPLY ON STAGE OF LAKE MICHIGAN-HURON, Foot Depth.	EFFECT OF CHANGE IN OUTFLOW THROUGH ST. CLAIR RIVER ON STAGE OF LAKE MICHIGAN-HURON, Foot Depth.	TOTAL EFFECT, NET CHANGE IN SUPPLY AND OUTFLOW ON STAGE OF LAKE MICHIGAN-HURON, Foot Depth.	REGULATED CONDITIONS. RISE OF FALL IN STAGE OF LAKE MICHIGAN-HURON DURING MONTH, IN FEET.	STAGE OF LAKE MICHIGAN-HURON, First of Month.	REGULATED STAGE LESS ACTUAL STAGE OF LAKE MICHIGAN-HURON. First of Month.	Mean of Month.	DISCHARGE INCREMENT OF ST. CLAIR RIVER PER FOOT RISE OF LAKE LEVEL, 100 c.f.s.	CHANGE IN OUTFLOW OF ST. CLAIR RIVER, 100 c.f.s.	REGULATED CONDITIONS, STAGE OF LAKE MICHIGAN-HURON, Mean of Month.
1888															
May		581.985													
June	582.128	2.270	+0.152	−259	−299	−0.0609	0.0000	−0.0609	+0.091	582.128	0.000	−0.030	209	− 6	582.240
July	2.280	2.290	−0.010	−295	−335	−0.0682	+0.0026	−0.0656	−0.076	2.219	−0.061	−0.094	209	−20	2.196
Aug.	2.270	2.250	−0.130	−293	−333	−0.0678	+0.0055	−0.0623	−0.192	2.143	−0.127	−0.158	209	−33	2.092
Sept.	2.140	2.030	−0.248	−275	−315	−0.0643	+0.0074	−0.0569	−0.305	1.951	−0.189	−0.218	191	−42	1.812
Oct.	1.892	1.755	−0.194	−272	−312	−0.0636	+0.0096	−0.0540	−0.248	1.646	−0.246	−0.273	191	−52	1.482
Nov.	1.698	1.640	−0.256	−226	−266	−0.0543	+0.0117	−0.0426	−0.299	1.398	−0.300	−0.322	191	−61	1.318
Dec.	1.442	1.245	−0.237	− 81	−121	−0.0247	+0.0134	−0.0113	−0.248	1.099	−0.343	−0.348	191	−67	0.897
1889															
Jan.	1.205	1.165	−0.067	− 25	− 65	−0.0133	+0.0127	−0.0006	−0.068	0.851	−0.354	−0.354	175	−62	0.811
Feb.	1.138	1.110	−0.038	+ 33	− 7	−0.0014	+0.0128	+0.0114	−0.027	0.783	−0.355	−0.350	175	−61	0.760
Mar.	1.100	1.090	−0.025	+ 27	− 13	−0.0027	+0.0124	+0.0097	−0.015	0.756	−0.344	−0.339	175	−59	0.751
April	1.075	1.060	+0.040	+ 29	− 11	−0.0022	+0.0120	+0.0098	+0.050	0.741	−0.334	−0.329	175	−58	0.731
May	1.115	1.170	+0.253	− 83	−123	−0.0251	+0.0117	−0.0134	+0.240	0.791	−0.324	−0.330	175	−58	0.840
June	1.368	1.565	+0.307	−119	−159	−0.0324	+0.0131	−0.0193	+0.288	1.031	−0.337	−0.346	191	−66	1.219
July	1.675	1.785	+0.035	−173	−213	−0.0435	+0.0139	−0.0296	+0.005	1.319	−0.356	−0.371	191	−71	1.414
Aug.	1.710	1.635	−0.160	−175	−215	−0.0439	+0.0151	−0.0288	−0.189	1.324	−0.386	−0.400	191	−76	1.235
Sept.	1.550	1.465	−0.240	−173	−213	−0.0435	+0.0162	−0.0273	−0.267	1.135	−0.415	−0.428	191	−82	1.037
Oct.	1.310	1.155	−0.328	−143	−183	−0.0374	+0.0159	−0.0215	−0.350	0.868	−0.442	−0.453	175	−79	0.702
Nov.	0.982	0.810	−0.257	− 83	−123	−0.0251	+0.0167	−0.0084	−0.265	0.518	−0.464	−0.468	175	−82	0.342
Dec.	0.725	0.640	−0.047	− 7	− 47	−0.0096	+0.0170	+0.0074	−0.040	0.253	−0.472	−0.468	175	−82	0.172
1890															
Jan.	0.678	0.715	−0.003	− 17	− 57	−0.0116	+0.0167	+0.0051	+0.002	0.213	−0.465	−0.462	175	−81	0.253
Feb.	0.675	0.635	−0.050	+ 93	+ 53	+0.0108	+0.0166	+0.0274	−0.023	0.215	−0.460	−0.446	175	−78	0.189
Mar.	0.625	0.615	+0.105	+ 95	+ 55	+0.0112	+0.0156	+0.0268	+0.132	0.192	−0.433	−0.420	175	−73	0.195
April	0.730	0.845	+0.250	+109	+ 69	+0.0141	+0.0146	+0.0287	+0.279	0.324	−0.406	−0.392	175	−69	0.453
May	0.980	1.115	+0.345	+ 15	− 25	−0.0051	+0.0136	+0.0085	+0.353	0.603	−0.377	−0.373	175	−65	0.742
June	1.325	1.535	+0.275	−101	−141	−0.0288	+0.0133	−0.0155	+0.259	0.956	−0.369	−0.377	175	−66	1.158
July	1.600	1.665	+0.045	−173	−213	−0.0435	+0.0150	−0.0285	+0.017	1.215	−0.385	−0.399	191	−76	1.266
Aug.	1.645	1.625	−0.137	−155	−195	−0.0398	+0.0161	−0.0237	−0.161	1.232	−0.413	−0.425	191	−81	1.200
Sept.	1.508	1.390	−0.198	−133	−173	−0.0353	+0.0170	−0.0183	−0.216	1.071	−0.437	−0.446	191	−85	0.944
Oct.	1.310	1.230	−0.215	−119	−159	−0.0325	+0.0164	−0.0161	−0.231	0.855	−0.455	−0.463	175	−81	0.767
Nov.	1.095	0.960	−0.297	− 91	−131	−0.0268	+0.0170	−0.0098	−0.307	0.624	−0.471	−0.476	175	−83	0.484
Dec.	0.798	0.635	−0.218	− 31	− 71	−0.0145	+0.0173	+0.0028	−0.215	0.317	−0.481	−0.480	175	−84	0.155

a.—Net change = regulated transmitted supply from Lake Superior—diversion through Chicago Drainage Canal—actual transmitted supply from Lake Superior.
Regulated transmitted supply from Lake Superior, with diversion through Chicago Drainage Canal of 4000 c.f.s. = 65700 c.f.s. + 0000 c.f.s. = 69700 c.f.s.

1891															
Jan.	580.580	580.525	−0.142	+107	+ 67	+0.0137	+0.0172	+0.0309	−0.111	580.102	−0.478	−0.462	175	−81	580.063
Feb.	0.438	0.350	−0.048	+ 85	+ 45	+0.0092	+0.0148	+0.0240	−0.024	579.991	−0.447	−0.435	163	−71	579.915
Mar.	0.390	0.430	+0.200	+115	+ 75	+0.0153	+0.0140	+0.0293	+0.229	9.967	−0.423	−0.408	163	−67	580.022
April	0.590	0.750	+0.245	+ 79	+ 39	+0.0080	+0.0142	+0.0222	+0.267	580.196	−0.394	−9.383	175	−67	0.367
May	0.835	0.920	+0.110	− 7	− 47	−0.0096	+0.0134	+0.0038	+0.114	0.463	−0.372	−0.370	175	−65	0.550
June	0.945	0.970	−0.010	+ 3	− 37	−0.0076	+0.0132	+0.0057	−0.004	0.577	−0.368	−0.365	175	−64	0.605
July	0.935	0.900	−0.077	− 19	− 59	−0.0121	+0.0130	+0.0009	−0.076	0.573	−0.362	−0.362	175	−63	0.538
Aug.	0.858	0.815	−0.148	− 21	− 61	−0.0125	+0.0130	+0.0005	−0.147	0.497	−0.361	−0.360	175	−63	0.455
Sept.	0.710	0.605	−0.288	− 7	− 47	−0.0096	+0.0130	+0.0034	−0.285	0.350	−0.360	−0.358	175	−63	0.247
Oct.	0.422	0.240	−0.360	− 19	− 59	−0.0121	+0.0129	+0.0008	−0.359	0.065	−0.357	−0.356	175	−62	579.884
Nov.	0.062	579.885	−0.207	+ 3	− 37	−0.0076	+0.0117	+0.0041	−0.203	579.706	−0.356	−0.354	163	−58	9.531
Dec.	579.855	9.825	+0.005	+ 65	+ 25	+0 0051	+0.0116	+0.0167	+0.022	9.503	−0.352	−0.344	163	−56	9.481
1892															
Jan.	9.860	9.895	+0.068	+ 77	+ 37	+0.0076	+0.0111	+0.0187	+0.087	9.525	−0.335	−0.326	163	−53	9.569
Feb.	9.928	9.960	+0.022	+149	+109	+0.0223	+0.0104	+0.0327	+0.055	9.612	−0.316	−0.300	163	−49	9.660
Mar.	9.950	9.940	+0.035	+185	+145	+0.0297	+0.0093	+0.0390	+0.074	9.667	−0.283	−0.264	163	−43	9.676
April	9.985	580.030	+0.173	+153	+113	+0.0231	+0.0081	+0.0312	+0.204	9.741	−0.244	−0.228	163	−37	9.802
May	580.158	0.285	+0.372	+ 51	+ 11	+0.0023	+0.0070	+0.0093	+0.381	9.945	−0.213	−0.208	163	−34	580.077
June	0.530	0.775	+0.320	− 21	− 61	−0.0125	+0.0073	−0.0052	+0.315	580.326	−0.204	−0.206	175	−36	0.569
July	0.850	0.925	+0.115	− 49	− 89	−0.0182	+0.0075	−0.0107	+0.104	0.641	−0.209	−0.214	175	−38	0.711
Aug.	0.965	1.005	−0.053	− 51	− 91	−0.0186	+0.0079	−0.0107	−0.064	0.745	−0.220	−0.225	175	−39	0.779
Sept.	0.912	0.820	−0.204	− 63	−103	−0.0210	+0.0083	−0.0127	−0.217	0.681	−0.231	−0.238	175	−42	0.582
Oct.	0.708	0.595	−0.263	− 41	− 81	−0.0165	+0.0088	−0.0077	−0.271	0.464	−0.244	−0.248	175	−43	0.347
Nov.	0.445	0.295	−0.277	+ 15	− 25	−0.0051	+0.0091	+0.0040	−0.273	0.193	−0.252	−0.250	175	−44	0.045
Dec.	0.168	0.040	−0.193	+ 71	+ 31	+0.0063	+0.0082	+0.0145	−0.179	579.920	−0.248	−0.241	163	−39	579.799
1893															
Jan.	579.975	579.910	−0.043	+178	+138	+0.0282	+0.0077	+0.0359	−0.007	9.741	−0.234	−0.216	163	−35	9.694
Feb.	9.932	9.955	+0.070	+215	+175	+0.0358	+0.0065	+0.0423	+0.112	9.734	−0.198	−0.177	163	−29	9.778
Mar.	580.002	580.050	+0.258	+213	+173	+0.0354	+0.0051	+0.0405	+0.298	9.846	−0.156	−0.136	163	−22	9.914
April	0.260	0.470	+0.442	+166	+126	+0.0257	+0.0042	+0.0299	+0.472	580.144	−0.116	−0.101	175	−18	580.369
May	0.702	0.935	+0.398	+ 59	+ 19	+0.0039	+0.0031	+0.0070	+0.405	0.616	−0.086	−0.082	175	−14	0.853
June	1.100	1.265	+0.205	− 41	− 81	−0.0165	+0.0031	−0.0134	+0.192	1.021	−0.079	−0.085	191	−15	1.179
July	1.305	1.345	−0.037	− 78	−118	−0.0241	+0.0036	−0.0205	−0.057	1.213	−0.092	−0.102	191	−18	1.243
Aug.	1.268	1.190	−0.233	− 93	−133	−0.0271	+0.0044	−0.0027	−0.256	1.156	−0.112	−0.124	191	−24	1.066

a.—Net change = regulated transmitted supply from Lake Superior—diversion through Chicago Drainage Canal—actual transmitted supply from Lake Superior.
Regulated transmitted supply from Lake Superior, with diversion through Chicago Drainage Canal of 4000 c.f.s. = 65700 c.f.s. + 4000 c.f.s. = 69700 c.f.s.

TABLE 41.

EFFECT ON WATER LEVELS OF LAKE ERIE, OF REGULATION OF LAKE SUPERIOR, TO COMPENSATE FOR DIVERSION OF 4000 CUBIC FEET PER SECOND THROUGH CHICAGO DRAINAGE CANAL.

DATE.	WATER LEVELS OF LAKE ERIE AT CLEVELAND, O.		RISE OR FALL IN STAGE OF LAKE ERIE, DURING MONTH,	NET CHANGE IN TRANSMITTED SUPPLY,	EFFECT OF NET CHANGE IN TRANSMITTED SUPPLY, ON STAGE OF LAKE ERIE,	EFFECT OF CHANGE IN CUTFLOW THROUGH NIAGARA RIVER ON STAGE OF LAKE ERIE,	TOTAL EFFECT NET CHANGE TRANSMITTED SUPPLY AND OUTFLOW, ON STAGE OF LAKE ERIE,	REGULATED CONDITIONS.		REGULATED STAGE LESS ACTUAL STAGE OF LAKE ERIE.		DISCHARGE INCREMENT OF NIAGARA RIVER PER FOOT RISE OF LAKE LEVEL.	CHANGE IN OUTFLOW OF NIAGARA RIVER,	REGULATED CONDITIONS, STAGE OF LAKE ERIE,
	First of Month.	Mean of Month.	In Feet.	100 c.f.s.	Foot Depth.	Foot Depth.	Foot Depth.	RISE OR FALL IN STAGE OF LAKE ERIE, DURING MONTH, In Feet.	STAGE OF LAKE ERIE, First of Month.	First of Month.	Mean of Month.	100 c.f.s.	100 c.f.s.	Mean of Month.
1888														
May		572.98												
June	573.04	3.11	+0.14	− 6	−0.0051	0.0000	−0.0051	+0.135	573.040	0.000	−0.002	251	− 1	573.108
July	3.18	3.26	+0.03	−20	−0.0169	+0.0010	−0.0159	+0.014	3.175	−0.005	−0.013	251	− 3	3.247
Aug.	3.21	3.16	−0.27	−33	−0.0279	+0.0040	−0.0239	−0.294	3.189	−0.021	−0.033	251	− 8	3.127
Sept.	2.94	2.72	−0.40	−42	−0.0358	+0.0081	−0.0277	−0.428	2.895	−0.045	−0.059	232	−14	2.661
Oct.	2.54	2.35	−0.16	−52	−0.0443	+0.0131	−0.0312	−0.191	2.467	−0.073	−0.088	232	−20	2.262
Nov.	2.38	2.41	−0.03	−61	−0.0520	+0.0187	−0.0333	−0.063	2.276	−0.104	0.120	232	−28	2.290
Dec.	2.35	2.29	−0.05	−67	−0.0571	+0.0247	−0.0324	−0.082	2.213	−0.137	−0.153	232	−35	2.137
1889														
Jan.	2.30	2.31	−0.07	−62	−0.0529	+0.0304	−0.0225	−0.092	2.131	−0.169	−0.180	232	−42	2.130
Feb.	2.23	2.15	−0.16	−61	−0.0520	+0.0344	−0.0176	−0.178	2.039	−0.191	−0.200	214	−43	1.950
Mar.	2.07	1.99	+0.09	−59	−0.0507	+0.0351	−0.0156	+0.074	1.861	−0.209	−0.217	214	−46	1.773
April	2.16	2.34	+0.27	−58	−0.0498	+0.0378	−0.0120	+0.258	1.935	−0.225	−0.231	232	−54	2.109
May	2.43	2.52	+0.31	−58	−0.0494	+0.0427	−0.0067	+0.303	2.193	−0.237	−0.240	232	−56	2.280
June	2.74	2.95	+0.31	−66	−0.0563	+0.0439	−0.0124	+0.298	2.496	−0.244	−0.250	232	−58	2.700
July	3.05	3.15	−0.05	−71	−0.0605	+0.0461	−0.0144	−0.064	2.794	−0.256	−0.263	232	−61	2.887
Aug.	3.00	2.84	−0.36	−76	−0.0648	+0.0486	−0.0162	−0.376	2.730	−0.270	−0.278	232	−64	2.562
Sept.	2.64	2.45	−0.40	−82	−0.0699	+0.0515	−0.0184	−0.418	2.354	−0.286	−0.295	232	−68	2.155
Oct.	2.24	2.03	−0.34	−79	−0.0679	+0.0511	−0.0168	−0.357	1.936	−0.304	−0.312	214	−67	1.718
Nov.	1.90	1.76	−0.01	−82	−0.0704	+0.0539	−0.0165	−0.026	1.579	−0.321	−0.329	214	−70	1.431
Dec.	1.89	2.02	+0.31	−82	−0.0704	+0.0566	−0.0138	+0.296	1.553	−0.337	−0.344	214	−74	1.676
1890														
Jan.	2.20	2.38	+0.32	−81	−0.0696	+0.0590	−0.0106	+0.309	1.849	−0.351	−0.356	232	−83	2.024
Feb.	2.52	2.67	+0.21	−78	−0.0665	+0.0652	−0.0013	+0.209	2.158	−0.362	−0.362	232	−84	2.308
Mar.	2.73	2.79	+0.31	−73	−0.0622	+0.0653	+0.0031	+0.313	2.367	−0.363	−0.362	232	−84	2.428
April	3.04	3.28	+0.41	−69	−0.0588	+0.0648	+0.0060	+0.416	2.680	−0.360	−0.357	232	−83	2.923
May	3.45	3.62	+0.35	−65	−0.0549	+0.0680	+0.0131	+0.363	3.096	−0.354	−0.348	251	−87	3.272
June	3.80	3.99	0.00	−66	−0.0558	+0.0655	+0.0097	+0.010	3.459	−0.341	−0.336	251	−84	3.654
July	3.80	3.61	−0.42	−76	−0.0642	+0.0636	−0.0006	−0.421	3.469	−0.331	−0.332	251	−83	3.278
Aug.	3.38	3.15	−0.32	−81	−0.0685	+0.0637	−0.0048	−0.325	3.048	−0.332	−0.334	232	−77	2.816
Sept.	3.06	2.98	−0.18	−85	−0.0725	+0.0607	−0.0118	−0.192	2.723	−0.337	−0.343	232	−80	2.637
Oct.	2.88	2.79	−0.10	−81	−0.0691	+0.0628	−0.0063	−0.106	2.531	−0.349	−0.352	232	−82	2.438
Nov.	2.78	2.76	−0.14	−83	−0.0708	+0.0639	−0.0069	−0.147	2.425	−0.355	−0.358	232	−83	2.402
Dec.	2.64	2.53	−0.22	−84	−0.0716	+0.0652	−0.0064	−0.226	2.278	−0.362	−0.365	232	−85	2.165

1891															
Jan.	572.42	572.31	−0.12	−81	−0.0691	+0.0662	−0.0029	−0.123	572.052	−0.368	−0.370	214	−79	571.940
Feb.	2.30	2.29	+0.22	−71	−0.0610	+0.0623	+0.0013	+0.221	1.929	−0.371	−0.370	214	−79	1.920
Mar.	2.52	2.75	+0.16	−67	−0.0571	+0.0666	+0.0095	+0.170	2.150	−0.370	−0.365	232	−85	2.385
April	2.68	2.62	−0.15	−67	−0.0571	+0.0648	+0.0077	−0.142	2.320	−0.360	−0.356	232	−83	2.264
May	2.53	2.44	−0.02	−65	−0.0554	+0.0634	+0.0080	−0.012	2.178	−0.352	−0.348	232	−81	2.092
June	2.51	2.58	+0.02	−64	−0.0546	+0.0619	+0.0073	+0.027	2.166	−0.344	−0.340	232	−79	2.240
July	2.53	2.48	−0.19	−63	−0.0537	+0.0607	+0.0070	−0.183	2.193	−0.337	−0.334	232	−77	2.146
Aug.	2.34	2.21	−0.22	−63	−0.0537	+0.0594	+0.0057	−0.214	2.010	−0.330	−0.327	314	−70	1.883
Sept.	2.12	2.03	−0.28	−63	−0.0541	+0.0544	+0.0003	−0.280	1.796	−0.324	−0.324	214	−69	1.706
Oct.	1.84	1.65	−0.41	−62	−0.0533	+0.0544	+0.0011	−0.409	1.516	−0.324	−0.324	214	−69	1.326
Nov.	1.43	1.21	−0.19	−58	−0.0498	+0.0543	+0.0045	−0.186	1.107	−0.323	−0.321	196	−63	0.889
Dec.	1.24	1.28	+0.06	−56	−0.0485	+0.0501	+0.0016	+0.062	0.921	−0.319	−0.318	196	−62	0.962
1892															
Jan.	1.30	1.31	−0.10	−53	−0.0459	+0.0498	+0.0039	−0.096	0.983	−0.317	−0.315	196	−62	0.995
Feb.	1.20	1.10	−0.08	−49	−0.0424	+0.0491	+0.0067	−0.073	0.887	−0.313	−0.310	196	−61	0.790
Mar.	1.12	1.14	+0.30	−43	+0.0372	+0.0480	+0.0108	+0.311	0.814	−0.306	−0.300	196	−59	0.840
April	1.42	1.70	+0.68	−37	−0.0318	+0.0496	+0.0178	+0.698	1.125	−0.295	−0.286	214	−61	1.414
May	2.10	2.50	+0.78	−34	−0.0292	+0.0465	+0.0173	+0.797	1.823	−0.277	−0.268	232	−62	2.232
June	2.88	3.26	+0.44	−36	−0.0307	+0.0468	+0.0161	+0.456	2.620	−0.260	−0.252	251	−63	3.008
July	3.32	3.38	−0.12	−38	−0.0321	+0.0468	+0.0147	−0.105	3.076	−0.244	−0.236	251	−59	3.144
Aug.	3.20	3.03	−0.13	−39	−0.0332	+0.0412	+0.0080	−0.322	2.971	−0.229	−0.225	232	−52	2.805
Sept.	2.87	2.71	−0.44	−42	−0.0358	+0.0398	+0.0040	−0.436	2.649	−0.221	−0.219	232	−51	2.491
Oct.	2.43	2.15	−0.45	−43	−0.0367	+0.0391	+0.0024	−0.448	2.213	−0.217	−0.216	214	−46	1.934
Nov.	1.98	1.82	−0.30	−44	−0.0378	+0.0361	−0.0017	−0.302	1.765	−0.215	−0.216	214	−56	1.604
Dec.	1.68	1.55	−0.32	−39	−0.0335	+0.0365	+0.0030	−0.317	1.463	−0.217	−0.216	214	−46	1.334
1893															
Jan.	1.36	1.17	−0.15	−35	−0.0301	−0.0360	+0.0059	−0.144	1.146	−0.214	−0.214	196	−41	0.959
Feb.	1.21	1.25	+0.15	−29	−0.0249	+0.0349	+0.0100	+0.160	1.002	−0.208	−0.203	214	−43	1.047
Mar.	1.36	1.47	+0.48	−22	−0.0189	+0.0333	+0.0144	+0.494	1.162	−0.198	−0.191	214	−41	1.279
April	1.84	2.20	+0.78	−18	−0.0155	+0.0309	+0.0154	+0.795	1.656	−0.184	−0.176	232	−41	2.024
May	2.62	3.04	+0.52	−14	−0.0119	+0.0304	+0.0185	+0.538	2.451	−0.169	−0.160	232	−37	2.880
June	3.14	3.23	−0.05	−15	−0.0128	+0.0272	+0.0144	−0.036	2.989	−0.151	−0.144	251	−36	3.086
July	3.09	2.95	−0.31	−18	−0.0153	+0.0247	+0.0094	−0.301	2.953	−0.137	−0.132	232	−31	2.818
Aug.	2.78	2.61	−0.36	−24	−0.0205	+0.0230	+0.0025	−0.358	2.652	−0.128	−0.127	232	−29	2.483
Sept.	2.42	2.23	−0.36						2.294	−0.126					

TABLE 42.

EFFECT ON WATER LEVELS OF LAKE ONTARIO, OF REGULATION OF LAKE SUPERIOR, TO COMPENSATE FOR DIVERSION OF 4000 CUBIC FEET PER SECOND THROUGH CHICAGO DRAINAGE CANAL.

DATE.	WATER LEVELS OF LAKE ONTARIO AT OSWEGO, N.Y.		RISE OR FALL IN STAGE OF LAKE ONTARIO DURING MONTH,	NET CHANGE IN TRANSMITTED SUPPLY,	EFFECT OF NET CHANGE IN TRANSMITTED SUPPLY ON STATE OF LAKE ONTARIO,	EFFECT OF CHANGE IN OUTFLOW THROUGH ST. LAWRENCE RIVER ON STAGE OF LAKE ONTARIO,	TOTAL EFFECT, NET CHANGE IN TRANSMITTED SUPPLY AND OUTFLOW, ON STAGE OF LAKE ONTARIO,	REGULATED CONDITIONS.		REGULATED STAGE LESS ACTUAL STAGE OF LAKE ONTARIO,		REGULATED CONDITIONS, STAGE OF LAKE ONTARIO,
	First of Month.	Mean of Month.	In Feet.	100 c.f.s.	Foot Depth.	Foot Depth.	Foot Depth.	RISE OR FALL IN STAGE OF LAKE ONTARIO DURING MONTH, In Feet.	STAGE OF LAKE ONTARIO, First of Month.	First of Month.	Mean of Month.	Mean of Month.
1888												
May		246.24										
June	246.26	6.28	+0.05	− 1	−0.0011	0.0000	−0.0011	+0.049	246.260	0.000	0.000	246.280
July	6.31	6.34	−0.02	− 3	−0.0033	+0.0003	−0.0030	−0.023	6.309	−0.001	−0.002	6.338
Aug.	6.29	6.24	−0.25	− 8	−0.0088	+0.0013	−0.0075	−0.258	6.286	−0.004	−0.008	6.232
Sept.	6.04	5.85	−0.37	−14	−0.0153	+0.0038	−0.0115	−0.382	6.028	−0.012	−0.018	5.832
Oct.	5.67	5.49	−0.21	−20	−0.0220	+0.0074	−0.0146	−0.225	5.646	−0.024	−0.032	5.458
Nov.	5.46	5.42	−0.04	−28	−0.0308	+0.0120	−0.0188	−0.059	5.421	−0.039	−0.048	5.372
Dec.	5.42	5.41	+0.10	−35	−0.0385	+0.0179	−0.0206	+0.079	5.362	−0.058	−0.068	5.342
1889												
Jan.	5.52	5.62	+0.17	−42	−0.0463	+0.0243	−0.0220	+0.148	5.441	−0.079	−0.090	5.530
Feb.	5.69	5.76	+0.15	−43	−0.0474	+0.0311	−0.0163	+0.134	5.589	−0.101	−0.109	5.651
Mar.	5.84	5.93	+0.21	−46	−0.0507	+0.0360	−0.0147	+0.195	5.723	−0.117	−0.124	5.806
April	6.05	6.17	+0.19	−54	−0.0595	+0.0407	−0.0188	+0.171	5.918	−0.132	−0.142	6.028
May	6.24	6.32	+0.24	−56	−0.0613	+0.0480	−0.0133	+0.227	6.089	−0.151	−0.158	6.162
June	6.48	6.63	+0.24	−58	−0.0635	+0.0522	−0.0113	+0.229	6.316	−0.164	−0.170	6.460
July	6.72	6.82	−0.02	−61	−0.0668	+0.0556	−0.0112	−0.031	6.545	−0.175	−0.180	6.640
Aug.	6.70	6.57	−0.41	−64	−0.0701	+0.0591	−0.0110	−0.421	6.514	−0.186	−0.192	6.378
Sept.	6.29	6.01	−0.50	−68	−0.0745	+0.0626	−0.0119	−0.512	6.093	−0.197	−0.203	5.807
Oct.	5.79	5.57	−0.42	−67	−0.0738	+0.0644	−0.0094	−0.429	5.581	−0.209	−0.214	5.356
Nov.	5.37	5.17	+0.09	−70	−0.0771	+0.0671	−0.0100	+0.080	5.152	−0.218	−0.223	4.947
Dec.	5.46	5.74	+0.54	−74	−0.0815	+0.0702	−0.0113	+0.529	5.232	−0.228	−0.234	5.506
1890												
Jan.	6.00	6.25	+0.42	−83	−0.0914	+0.0736	−0.0178	+0.402	5.761	−0.239	−0.248	6.002
Feb.	6.42	6.60	+0.34	−84	−0.0920	+0.0817	−0.0103	+0.330	6.163	−0.257	−0.262	6.338
Mar.	6.76	6.93	+0.29	−84	−0.0920	+0.0849	−0.0071	+0.283	6.493	−0.267	−0.270	6.660
April	7.05	7.17	+0.30	−83	−0.0909	+0.0871	−0.0038	+0.296	6.776	−0.274	−0.276	6.894
May	7.35	7.53	+0.49	−87	−0.0948	+0.0909	−0.0039	+0.486	7.072	−0.278	−0.280	7.250
June	7.84	8.16	+0.24	−84	−0.0915	+0.0922	+0.0007	+0.241	7.558	−0.282	−0.282	7.878
July	8.08	7.99	−0.42	−83	−0.0904	+0.0919	+0.0015	−0.418	7.799	−0.281	−0.280	7.710
Aug.	7.66	7.32	−0.52	−77	−0.0839	+0.0912	+0.0073	−0.513	7.381	−0.279	−0.276	7.044
Sept.	7.14	6.97	−0.34	−80	−0.0876	+0.0865	−0.0011	−0.341	6.868	−0.272	−0.272	6.698
Oct.	6.80	6.64	−0.12	−82	−0.0898	+0.0868	−0.0030	−0.123	6.527	−0.273	−0.274	6.366
Nov.	6.68	6.72	−0.06	−83	−0.0909	+0.0878	−0.0031	−0.063	6.404	−0.276	−0.278	6.442
Dec.	6.62	6.51	−0.27	−85	−0.0931	+0.0887	−0.0044	−0.274	6.341	−0.279	−0.281	6.229

SESSIONAL PAPER No. 54.

1891												
Jan.	246.35	246.19	−0.03	−79	−0.0865	+0.0900	+0.0035	−0.026	246.067	−0.283	−0.281	245.909
Feb.	6.32	6.45	+0.40	−79	−0.0865	+0.0887	+0.0022	+0.402	6.041	−0.279	−0.278	6.172
Mar.	6.72	6.99	+0.51	−85	−0.0931	+0.0881	−0.0050	+0.505	6.443	−0.277	−0.280	6.710
April	7.23	7.47	+0.13	−83	−0.0909	+0.0897	−0.0012	+0.129	6.948	−0.282	−0.282	7.188
May	7.36	7.25	−0.32	−81	−0.0882	+0.0925	+0.0043	−0.316	7.077	−0.283	−0.281	6.969
June	7.04	6.83	−0.35	−79	−0.0865	+0.0887	+0.0022	−0.348	6.761	−0.279	−0.278	6.552
July	6.69	6.55	−0.36	−77	−0.0843	+0.0881	+0.0038	−0.356	6.413	−0.277	−0.275	6.275
Aug.	6.33	6.11	−0.43	−70	−0.0767	+0.0868	+0.0101	−0.420	6.057	−0.273	−0.268	5.842
Sept.	5.90	5.68	−0.54	−69	−0.0760	+0.0810	+0.0050	−0.535	5.637	−0.263	−0.260	5.420
Oct.	5.36	5.04	−0.62	−69	−0.0760	+0.0795	+0.0035	−0.616	5.102	−0.258	−0.256	4.784
Nov.	4.74	4.44	−0.32	−63	−0.0698	+0.0759	+0.0061	−0.314	4.486	−0.254	−0.251	4.189
Dec.	4.42	4.41	+0.04	−62	−0.0687	+0.0742	+0.0055	+0.046	4.172	−0.248	−0.245	4.162
1892												
Jan.	4.46	4.51	+0.04	−62	−0.0687	+0.0724	+0.0037	+0.044	4.218	−0.242	−0.240	4.270
Feb.	4.50	4.48	+0.04	−61	−0.0676	+0.0712	+0.0036	+0.044	4.262	−0.238	−0.236	4.244
Mar.	4.54	4.61	+0.36	−59	−0.0653	+0.0700	+0.0047	+0.365	4.306	−0.234	−0.232	4.378
April	4.90	5.19	+0.32	−61	−0.0676	+0.0685	+0.0009	+0.321	4.671	−0.229	−0.228	4.962
May	5.22	5.25	+0.31	−62	−0.0687	+0.0682	−0.0005	+0.310	4.992	−0.228	−0.228	5.022
June	5.53	5.81	+0.53	−63	−0.0694	+0.0702	+0.0008	+0.531	5.302	−0.228	−0.228	5.582
July	6.06	6.32	+0.22	−59	−0.0650	+0.0699	+0.0049	+0.225	6.833	−0.227	−0.224	6.096
Aug.	6.28	6.24	−0.14	−52	−0.0570	+0.0706	+0.0136	−0.126	6.058	−0.222	−0.215	6.025
Sept.	6.14	6.04	−0.32	−51	−0.0562	+0.0641	+0.0079	−0.312	5.932	−0.208	−0.204	5.836
Oct.	5.82	5.60	−0.36	−46	−0.0507	+0.0616	+0.0109	−0.349	5.620	−0.200	−0.194	5.406
Nov.	5.46	5.33	−0.20	−46	−0.0507	+0.0582	+0.0075	−0.192	5.271	−0.189	−0.185	5.145
Dec.	5.26	5.20	−0.22	−46	−0.0507	+0.0557	+0.0050	−0.215	5.079	−0.181	−0.178	5.022
1893												
Jan.	5.04	4.87	−0.22	−41	−0.0454	+0.0526	+0.0072	−0.213	4.864	−0.176	−0.172	4.698
Feb.	4.82	4.76	+0.18	−43	−0.0476	+0.0505	+0.0029	+0.183	4.651	−0.169	−0.168	4.592
Mar.	5.00	5.24	+0.62	−41	−0.0454	+0.0496	+0.0042	+0.624	4.834	−0.166	−0.164	5.076
April	5.62	5.99	+0.95	−41	−0.0452	+0.0499	+0.0047	+0.955	5.458	−0.162	−0.160	5.830
May	6.57	7.15	+0.69	−37	−0.0405	+0.0499	+0.0094	+0.699	6.413	−0.157	−0.152	6.998
June	7.26	7.37	+0.02	−36	−0.0392	+0.0484	+0.0092	+0.011	7.112	−0.148	−0.144	7.226
July	7.24	7.11	−0.40	−31	−0.0338	+0.0455	+0.0117	−0.388	7.101	−0.139	−0.133	6.977
Aug.	6.84	6.57	−0.40	−29	−0.0318	+0.0404	+0.0086	−0.391	6.713	−0.127		

RETURN

[57]

TO AN ORDER OF THE HOUSE OF COMMONS, dated the 7th December 1910, calling for all correspondence between the Government of Canada or the Right Honourable, the First Minister, and the Government of Manitoba or the Premier of Manitoba, referring to the demand of Manitoba for an extension of boundaries and an increase in subsidy.

CHAS. MURPHY,
Secretary of State.

PROVINCE OF MANITOBA

Premier's Office, Winnipeg, Manitoba,
17th October, 1910.

My Dear Sir Wilfrid,—

Re Terms of Extension of Manitoba Boundaries.

Although I have as yet received no reply to my letter of January 8, 1910, I fe' 'he matter of the future development and prosperity of this province dema.. that I should again urge and request you to give us an answer to our pro; .ls as to the terms upon which the territory already agreed upon should be transferred to Manitoba.

I have read carefully all your published statements on the question while you were in the west. I noted your public suggestion that I should go to Ottawa and enter into conference. As to this I am willing to-day, to-morrow or any day you name to visit Ottawa.

My sense of what is right and just for the welfare of the province will compel me to simply repeat and ask, as our delegates, Messrs. Rogers and Campbell, asked, for the same equality of treatment as is enjoyed by our sister provinces. From some of your published statements you are reported as having

said that you never made any offer at all, and that Messrs. Rogers and Campbell were mistaken. However, be this as it may, surely the time has now arrived when you should be in a position to state what terms you are prepared to rdecommend to your Parliament for acceptance.

You have in your possession our proposal which we regard as fair and just. If you are not prepared to accept them, and will undertake to make an alternative proposition, I will undertake and endeavor to meet you in every possible way so long as your proposition will have for its basis equality of treatment. Anything short of equality will mean the placing of Manitoba in a subordinate position towards her sister provinces in Confederation. Possibly you can think I do not represent public opinion in this provinse in asking for this equality of treatment.

Let me go a step further and say that if you will make your proposition and it turns out to be such as I cannot accept, I will with your approval undertake to submit the two propositions direct to the people of this province for their consideration and decision on the principle of the initiative and referendum.

If, however, you are prepared to offer us terms of equality of treatment with the other provinces, which we have so repeatedly urged, I will at once accept, and at the approaching sessions of both parliaments all these matters might be agreed to and confirmed by legislation.

An early reply will be greatly appreciated.

Yours sincerely,

(Sgd.) R. P. ROBLIN.

To the Right Honourable,

Sir Wilfrid Laurier, G. C. M. G.,
Prime Minister,

Ottawa, Ontario.

PRIME MINISTER'S OFFICE,
CANADA.

OTTAWA, 22nd October, 1910

My dear Mr. Roblin,—

In answer to yours of the 17th instant, I beg to say that I will be very happy to meet you and to resume negotiations on the question of the extension of the Manitoba boundaries, at any time that may be convenient to you.

With reference to your letter of the 8th of January last, which you say remained unanswered by me, I have to tell you frankly that in my opinion my part of the correspondence was ended, as your letter was simply a repetition of

a suggestion which had been made by you in two previous communications, and which I had felt compelled to decline. I noticed that in some of your public utterances, you construed my not continuing the correspondence as acts of discourtesy. This is an opinion which I cannot entertain. At all events, I respectfully disclaim any such intention.

Believe me, dear Mr. Roblin,

Yours very sincerely,

(Sgd.) WILFRID LAURIER.

The Honourable R. P. Roblin,
Premier's Office,
Winnipeg, Man.

PROVINCE OF MANITOBA.

PREMIER'S OFFICE,
October 27, 1910.

My dear Sir Wilfrid,—

As requested by you in yours of October 22, I will visit Ottawa in the near future to discuss with you the terms upon which the boundaries of Manitoba may be extended.

With assurances of my personal regards,

Yours very respectfully,

(Sgd.) R. P. ROBLIN.

Right Honourable Sir Wilfrid Laurier, G. C. M. G.,
Ottawa, Ontario.

CANADIAN PACIFIC RAILWAY COMPANY'S TELEGRAPH.

NEW YORK, N. Y., Nov. 24, 1910.

Sir Wilfrid Laurier,—
Ottawa.

Will be in Ottawa to-morrow to resume discussion boundary matter 11.35 a.m.

(Sgd.) R. P. ROBLIN.

RETURN

[58]

Memorandum Respecting Finances of National Battlefield Commission.

Hon. Wm. Paterson,
Minister of Customs,
Ottawa.

Dear Mr. Patterson:—

I enclose herewith copy of memorandum respecting the finances of the National Battlefields Commission as on the 31st March, 1910, to be laid on the Table of the House of Commons.

Yours very truly,

T. C. BOVILLE,
Deputy Minister of Finance.
Ottawa, April 6th, 1910.

T. C Boville, Esq.,
Deputy Minister of Finance,
Ottawa.

My Dear Boville:—

I have the honour to enclose herewith a report of the finances of the Battlefields Commission to the 31st March, 1910. All the expenditures have been sent to Mr. Forsyth and I shall be glad if he will transfer quickly to the Audit Office, as I desire to have all accounts audited and passed so that I may turn the balance over to Mr. Dunsford.

I remain,
Yours very truly,
(sd.) J. M. COURTNEY,
Hon, Treas. Nat. Battlefield Commission.

Memorandum respecting the Finances of the National Battlefields Commission as on the 31st March, 1910.

The last memorandum was presented to the Commissioners on the 31st October last which included the interest credited by the Banks to that date. The present memorandum is prepared in consequence of the change in the office of the Hon. Treasurer, and does not include the interest accrued to date. One half year's interest of the funds in Ottawa will be credited on the 30th April (the current month) while the half year's interest of the funds at Quebec will be credited on the 30th June. The rate of interest allowed is 3½%. There are no further subscriptions to be received as far as the Hon. Treas. is aware. All the items of expenditure to the 31st March have been submitted to the Finance Depart-

ment together with all the accounts to that date. There only remain to complete the vouchers a few cheques drawn before the end of the month which are outstanding and not paid by the bank, but all accounts duly receipted have been transmitted to the Finance Department.

With this preface the Hon. Treasurer submits the statement of affairs.

Balance, B. of	Montreal,		Government	$300,000.00
	Ottawa	$240,693.09	Subscriptions....	488,251.34
"	Quebec	105,340.11	Contractor's securities ...	4,790.00
			Pageants	32,280.88
		346,033.20	Refunds..	3,730.69
			" Land Sales..	391.90
				829,444.81
Less cheques outstanding.		389.17	Less cheques drawn	483,800.78
		345,644.03		345,644.03

Taking the receipts and payments, the amount of cash dealt with by the Commission exceeds $1,300.00.

In the above statement the amount of cheques drawn is stated to be $483,800.78, made up of payments for services as follows:—

Contractors' securities repaid .. ..$	4,790.00	
Battlefields charges	14,605.79	
Deduction from land sales	220.85	
Purchase of properties	137,384.54	
Tercentenary..	326,799.60	
		$483,800.78
The total amount received on account of the Battlefields with interest is		$488,251.34
To this has to be added the sale of materials from the Cauchon property		391.90
Refund of overpayment, F. G. Todd		2.00
		$488,145.24

For which have been paid:—

Charges of management.. ....$	14,605.79	
Deductions from sales	220.85	
Purchase of properties..	137,384.54	152,211.18
Leaving available..		336,434.06

Out of this fund all expenses are now payable, and having regard to the fact that the English contributions are understood to be applied toward a monument, it will be as well if no funds are appropriated by Parliament to restrict the expenditure for the purchase of lands as was pointed out in the memorandum of October 31st last to $200,000 or $220,000.

The Tercentenary expenditure is to be found in the statement appended hereto—to put the matter in a summary statement, the accocunt is as follows:—

Government Grant	$300,000.00
Sales of tickets	32,380.88
Refunds	3,728.69
	336,009.57
Expenditure	326,799.60
Balance	$ 9,209.97

During the month of April (the current month) the balance has been reduced by a payment of $500 to the sum of $8,709.97.

Against this there are the following liabilities:—

Tablets say	$ 1,700.00
Champlain Society	5,000.00
	$ 6,700.00

There may be a few dollars of expressage and repairs on account of the piece of silver to be presented to Mr. Lascelles, and the cost of the balance of the Tablets is rather a guess work based on the amount already paid; but these expenditures should be closed immediately, the business of the Tablets has remained open for a considerable time. It would be advisable as early as possible to close the Tercentenary accounts and transfer the small balance to the Battlefields Fund. The balances agreeing with the Bank books are:—

Balance Tercentenary	$ 9,209.97
For purchase of properties	336,434.06
	$345,644.03

TERCENTENARY CELEBRATION

Expenses Compared with Appropriation, 31st March, 1910

Name of Appropriation	Amount	Sale of Tickets	Refunds	Total	Expenditure	Excess	Saving
Contingencies	$ 5,000.00			$ 5,000.00	$ 6,208.73	$ 1,208.73	
L'Abitation de Quebec	5,000.00			5,000.00	5,293.79	293.79	
Le Don de Dieu	12,000.00		13.50	12,013.30	9,703.58		2,309.72
Musical Programme	8,000.00			8,000.00	5,993.60		2,006.40
Decorations	18,500.00			18,500.00	18,733.10	233.10	
Tablets	5,000.00			5,000.00	1,757.50		3,242.50
Men of the Watch	2,000.00			2,000.00	1,837.50		162.50
Athletic Sports	5,000.00			5,000.00	5,000.00		
Fire Works	15,750.00			15,750.00	16,187.00	428.00	
Pageants	109,000.00	32,280.88	3,154.04	144,434.92	154,006.11	9,571.19	
Stand Monument Champlain	2,500.00			2,500.00	3,505.12	1,005.12	
Medals	3,000.00			3,000.00	3,643.54	643.54	
Reception of H. R. H. The Prince of Wales	50,000.00		198.59	50,198.59	43,992.63		6,205.96
Local Aid for Visitors	15,000.00			15,000.00	15,000.00		
Reception Visiting Officers and Men	7,000.00		114.25	7,114.25	9,919.80	2,805.55	
Posters	6,250.00			6,250.00	6,139.42		110.58
Stand, Military Review	9,000.00			9,000.00	5,324.10		3,675.90
Press	2,000.00		36.54	2,036.54	1,962.88		73.66
Expenses, Commissioners, Guests and Officials	20,000.00		211.97	20,211.97	12,600.20		7,611.77
	$300,000.00	$ 32,280.88	$ 3,728.69	$336,009.57	$326,799.60	$ 16,189.02	$ 25,398.99
					$ 9,209.97	$ 9,209.97	

Report from The National Battlefields Commission

QUEBEC, December 12, 1910.

To His Excellency The Governor in Council

The National Battlefields Commission was constituted by the Statute 7-8 Edward VII., Chapter 57, for the purpose of acquiring and preserving the great historic battlefields at Quebec and for the management and control subject to the provisions of the Act, of the lands to be vested in or acquired by the Commission for this purpose, and of the moneys appropriated by the Parliament of Canada and of the generous contributions which it was anticipated would be made by the various Provincial governments, as well as by municipal or other bodies, and by many private individuals.

Section 6 of this Act gave to the Commission the powers of expropriation of a railway company under the Railway Act. This was subsequently modified by the Act 9-10 Edward VII., chapter 41, which substitutes the powers under the Expropriation Act for those under the Railway Act.

Section 9 of the Act authorizes the Governor in Council to appropriate for the purposes of the Commission all the land or immovable property now vested in His Majesty for the military or other public purposes of Canada and forming part of the aforesaid battlefields.

Section 10 of the Act provides that no land or immovable property shall be purchased or acquired by the Commission except with the previous authority of Parliament and by a subsequent Act (7-8 Edw. VII., chap. 58), the sanction of Parliament was given to the acquisition subject to the approval of the Governor in Council of certain lands and immovable property set forth in a schedule forming part of the said Act.

Section 8, of the original Act (7-8 Edw. VII., chap. 57), granted a sum of three hundred thousand dollars out of the Consolidated Revenue Fund of Canada for the purposes authorized by the Act and Section 16 empowered the Commission to arrange for and carry out a celebration in every respect worthy and fit, of the founding of Quebec by Samuel de Champlain and the dedication of the battlefields to the general public purposes of Canada. The Commission was further authorized by the said Section 16, to expend and lay out, for the purposes of the said celebration, such portion of the said sum of three hundred thousand dollars therein before appropriated as the Commission might authorize, subject to the sanction and approval of the Governor in Council.

Quebec Tercentenary Celebration.

The Quebec Tercentenary Celebration was organized and carried out in a way which was meant to be worthy of the occasion and of Canada and the

Commission believe that the general verdict was that this end had been attained.

The celebration was made memorable by the presence of H. R. H. the Prince of Wales, now His Most Gracious Majesty King George V., as personal representative of our beloved Sovereign, the late King, it derived a world wide interest from the presence of special missions from the Governments of France and the United States, of representatives from the self governing Dominions of the Empire, of the fleets of three nations, of a special representative of the British Army in the person of Field Marshall the Earl Roberts, V. C., K. G., of descendants of Wolfe, Montcalm, Levis, Murray, Fraser, Guy Carleton, Elgin, of the Mayor of Brouage, the birthplace of Champlain, and of many other distinguished personages from abroad, as well as by the gathering in Quebec of the greater number of the men of note in Canada.

The scope given to the celebration necessarily entailed heavy expenditure, of which account was rendered in due course to the Minister of Finance, as called for by Section 12 of the Act, but the Commission is pleased to say that it was kept within the limits of the grant of $300,000 made by the Act, the balance left over being $8,709.97, out of which there still remains to be paid two amounts which will not exceed $6,700, leaving a net balance of about $2,000.

Subscriptions to the Battlefields Fund.

The subscriptions received for the Battlefields fund amount to $488,-251.34 and include contributions from all over the British Empire. Governments, municipalities, other corporations and individuals of all classes and conditions responded generously to the action of Parliament in creating this Commission and undertaking the preservation and maintenance of the battlefields of Quebec as a national work.

The Provinces of the Dominion contributed the following amounts:

Ontario	$ 100,000
Quebec	100,000
Nova Scotia	10,000
New Brunswick	7,500
Manitoba	10,000
British Columbia	10,000
Prince Edward Island	2,500
Alberta	10,000
Saskatchewan	10,000

The Governments of Ontario and Quebec were entitled under Section 1, Sub-section 2, of the Act to appoint one commissioner each and the Honourable J. S. Hendrie, C. V. C., was appointed by the Government of Ontario, and the Honourable L. A. Taschereau by the Government of Quebec.

Quebec Battlefields Park.

After acquiring some of the lands required for the Park, when the necessity arose to resort to expropriation in some instances, it was found that the powers conferred under "The Railway Act" would be very difficult to apply and might expose the Commission to costly and uncertain litigation. This necessitated the postponement of the negotiations then under way and

an application to Parliament to have the Act amended. This was done by the Act 9-10 Edward VII., chapter 41, which as already stated substituted the powers and procedure under "The Expropriation Act" for those under "The Railway Act." This Act was aassented to on the 4th of May, 1910. Since then the Commission has proceeded, as fast as circumstances, and the passing of the necessary orders in council would allow.

The projected Park which is to cover an area of some two hundred and twenty (220) acres and to extend from the St. Louis Gate on Grande Allee, near the Citadel, to and including the "Monument Field" where is erected the "*Monument des Braves*," on the Ste. Foy Road, will comprise the following

1. The greater part of the "Cove Fields,' 'about .... 63 acres.
2. The Greater part of the "Seminary Farm," including Lot No. 4440-156, about ....27 acres
3. The greater part of the Quebec Jail and Observatory grounds including streets and a few small plots of land, about....34 acres
4. The whole of the "Plains of Abraham," about .. ..75 acres
5. Part of the Merici Property, about .... 4 acres
6. Strips of land along Gilmour's Hill and other roadways, about .... 5 acres
7. The greater part of the "Monument Field, about ....12 acres

Total, about ....222 acres

The Commission has caused a plan to be worked out for this Park by the well known landscape architect, Mr. Frederick G. Todd, of Montreal, which plan though not definitely adopted in all its details by this Commission is practically so in its general outlines.

The Commission desires to explain how matters stand with reference to the different sections of the ground to be absorbed by the future Park.

Cove Fields.

These grounds are at present used in park for military purposes, and the Commission did not feel justified in accepting their transfer subject to the extensive reservations suggested by the Department of Militia and Defence.

An interview took place here on the 12th of July last between Colonel Fiset, Deputy Minister of Militia, accompanied by Colonel Pelltier, D. O. C., and two of the members of this Commission, the Chairman and the Honourable Mr. Turgeon, with reference to these grounds, and the Commissioners pointed out to the Deputy Minister of Militia the absolute necessity of removing the Laboratory and Fulminate Buildings and also the Rifle Range from these premises to some other site outside of the limits of the proposed Park as otherwise the plan outlined and approved, on which subscriptions had been collected throughout Canada and the Empire, could not be carried out.

Two main driveways will have to be laid out, one along the northern limit of the Park, from the City walls to the western extremity of the Plains of Abraham, traversing some of the most important points of the battlefields, and the other along the slope of the cliff overlooking the St. Lawrence, affording a view of the river and coves which were the scene of Wolfe's landing and final operations. This avenue is important from both

the historical and scenic point of view, but it cannot be properly carried out unless a right of way for the avenue is secured through part of the land leased to the Ross Rifle Company, as shown in red on the annexed plan. This avenue, however, would not interfere with any of the buildings of the Company, being located far below them on the slope of the hill and on ground which is not utilized by the Company. The Commission hopes that a satisfactory agreement may be arrived at whereby this important part of the Park plans may be carried out.

Seminary Farm.

This property is situated between the Cove Fields and the Observatory Property and it was necessary to acquire for the Park the portion of land separating the two government properties, a total superficies of 1,276,180 square feet, of this, the part belonging to the Quebec Seminary, 1,175,716 square feet in area was purchased for the price of one hundred and twenty-nine thousand one hundred and thirty-seven dollars ($129,137.00), which may be considered as very favourable terms.

The Commission offered twenty-six cents ($.26) per square foot for a plot of about 100,000 square feet, belonging to the Rev'd Dominican Brothers, which constitutes the balance of the land required on the Seminary Farm. This offer was refused and this plot will therefore have to be expropriated.

As the name 'Seminary Farm' applied to this property might be misleading, the Commission desires to point out that this land had been subdivided into building lots in 1902 and the part purchased by the Dominican Brothers (in 1907) was to have been built upon in the near future, which would no doubt have resulted in the sale of the other lots.

Quebec Jail and Observatory Grounds.

Negotiations were entered into between the Commission and the Quebec Government with regard to the transfer, by the latter to the former, of the greater part of these grounds, and the Commission is happy to report that the transfer by the Government of the Province of Quebec of the Jail Property is now agreed upon, subject to the Government's rights to maintain the Jail thereon until such time as it may find suitable to remove it.

As to the parcel of land situated between the Jail Property and the land acquired by the Commission from the Seminary, which is commonly designated as the Observatory Property, it would appear that the respective rights of the Federal and Provincial Governments in this property are not clearly defined, and the Commission recommends that the two Governments abandon to it such rights and interests as they may respectively hold in the said property, and that the Commission be authorized to assume the payment of the ground rents affecting these properties and which have been paid so far by the Provincial Government, deducting a proportion of the said ground rent for the ground reserved by the Quebec Government for the purposes of the Jail.

The Commission is enabled to state that the Quebec Government has already intimated its readiness to abandon such rights as it may possess in the Observatory Property, and it also desires to point out that a reservation might be made for the plot of ground, of about 62,500 square feet (250 feet square), necessary for the Observatory Building and annexes, as there

can be no objection to the Observatory remaining within the limits of the Park.

Plains of Abraham.

The grounds generally designated as "The Plains of Abraham," lying to the south-west of the Jail Property were ceded to this Commission by the City of Quebec on July 22nd, 1908. They extend from the cliff to the St. Louis Road and westerly to the "Merici Property," belonging to the Ursuline Nuns, and cover an area of about 75 acres.

Merici Property.

Adjoining the Plains of Abraham to the west lies the Merici Property (previously known as "Marchmont"), belonging to the Ursuline Nnus. The part of this property skirting the brow of the cliff overlooking the St. Lawrence, commands a general view of Wolfe's Cove and was the site of the French outpost stationed there to watch over the movements of Saunder's fleet and prevent a landing. It will be necessary to purchase a strip of this land, of varying width and covering about four (4) acres in superficies, both for its historical value and scenic beauty and also to reach Gilmour's Hill, near the head of the ravine which was escaladed by Wolfe's army.

The valuators employed by the Commission did not agree on the price for this land and no offers have as yet been made towards its purchase.

Strips of Land Along Gilmour's Hill and Other Roadways.

No steps have as yet been taken to acquire these strips, as changes may be advisable in connection with this part of the project, principally with regard to the Belvedere Road, which in the opinion of the Commission should be abandoned as far as the Park is concerned, owing to the laying of water and drainage pipes under that road which would be a constant source of trouble and expense in the maintenance of a park avenue. Moreover, the Commission is of the opinion that it would greatly improve the general scheme of the work if, instead of utilizing the existing Belvedere Road, a new avenue was opened out from St. Louis Road to the Monument Field, in line with the "Monument des Braves." Full advantage would thus be taken of this handsome monument, which would then become an important and striking feature of the Park.

The Commission has opened negotiations with the municipal authorities of the Town of Montcalm, wherein the proposed new avenue would be situated, to obtain from them the land required, subject to the construction and maintenance of the avenue by the Commission.

Ste. Foy Monument Field.

This ground was the scene of some of the most stirring episodes of the second battle of the Plains, between the armies of Levis and Murray, and on it is erected the "Monument des Braves," or Ste. Foy Monument. It is subdivided into building lots and some houses had already been erected upon it before the Quebec Battlefields Park had been projected.

The following properties have been purchased by the Commission in this section at prices authorized by orders in council:

From Whom Bought	Area in Sq. Feet.	Rate per Sq. Foot.	Price
Sir George Garneau, who purchased the property (lot and house thereon) for the Commission from Jos. Cauchon (Order in Council, Dec. 3rd, 1908, ...	13,065	not specified $ c	$ c 7,846 55
Joseph Robitaille, fils	10,740	0.077	826 98
Joseph Robitaille, fils	2,280	0.132	300 96
Joseph Robitaille	2,400	0.1325	318 00
Joseph Robitaille	2,280	0.132	300 96
Theodore Lagace	2,520	0.132	332 64
Joseph Robitaille	House		2,500 00
Theodore Lagace	House		2,200 00
Total.....	....	... .	14,626 09
Deducting the amount obtained for the material of the Cauchon house, now demolished	....	... .	380 00
Actual cost of the above properties..	....	... .	14,626 09

The houses bought from Robitaille and Lagace, which, by the consent of the Commission, may be occupied by their late proprietors till the first of May next, are to be demolished after that date.

Offers were made by the Commission for the purchase of the other lots of land on this Monument Field, but were refused, and proceedings for their expropriation are being taken.

"Monument des Braves."

The "Monument des Braves," erected to the memory of Levis and Murray, and the brave men who fought under them at the Battle of Ste. Foy (28th of April, 1760), and the plot of land upon which it is erected are now the property of this Commission, they having been transferred to the latter by the Quebec Government for the nominal sum of one dollar.

Immediate repairs will have to be made to this Monument for its preservation, which repairs, according to an architect's valuation, are estimated at about five hundred dollars ($500.)

No. 4 Martello Tower.

The Government of Canada, having acquired from the Nuns of the Hotel Dieu du Precieux Sang, the land whereon Martello Tower No. 4 is erected, subject to the condition that the title to the property is good only until such time as the tower thereon erected shall have been demolished, the said Martello Tower, together with the land on which it is erected, were conveyed to the National Battlefields Commission by Order in Council of the 22nd of May, 1909, (P. C., 1095) and letters-patent based thereon, with

the express stipulation that it is a condition of the grant that the said Martello Tower be maintained and preserved in good order and condition to the satisfaction of the Minister of Militia and Defence of Canada, and that, should there be default on the part of the grantee in so maintaining and preserving the said Tower, the transfer should thereupon become null and void and the said property revert to the Crown.

The Commission has had a careful examination of the Tower made by a competent architect, who reports that its repairs and restoration will cost about six thousand dollars ($6000.)

The land on the east and west of the Tower and up to its walls belongs to private parties but is not built over. If the Tower is to be preserved it is necessary to acquire the adjoining lots on both sides. This would probably cost about $1200, but the purchase of this ground is not provided for by any of the Statutes of Canada respecting the National Battlefields. The Commission therefore recommends that an act of Parliament be passed to empower it to acquire this land, subject to the approval of the Governor in Council as to the price. The Commission further recommends that suitable provision be made for the expenditure required for the restoration and maintenance of the Tower.

Disposal of the Available Funds and Probable Cost of the Works for the Park.

The Commission ventures to draw the attention of the Government to the fact that the funds now at its disposal (about $340,000) are to be used solely for the acquirement of the lands necessary for the Battlefields Park, as these funds were subscribed, from all parts of the British Empire, and are now held in trust by this Commission for that special object, with the exception, however, of the moneys subscribed in England, which it is understood are to be applied towards the erection of a monument in the Battlefields Park. It is therefore expected that the Parliament of Canada will provide the funds necessary for the converting of the said grounds into a National Park, as well as for the proper administration of this public service.

The estimates that can be based on the preliminary plans are, by their very nature, only approximate, and the extent of the work must be controlled largely by the appropriation that Parliament is willing to make. But, in the opinion of the Commission, such provision, apart from annual cost of maintenance, should be not less than two hundred thousand dollars.

In carrying out the work, the Commission is of the opinion that the avenues should be made with great care and in the best manner possible, so as to minimize the cost of maintenance and repairs. This will mean an increased initial outlay which, however, would be recouped by the decrease in expenses of maintenance.

The Commission desires to inquire whether the Government will provide every year, upon an estimate furnished by the Commission, for the works to be carried out that year and for the maintenance of the Park after its completion, or whether the Government intends to place every year at the disposal of the Commission, a certain fixed amount for the execution of the Park till completed and another fixed sum for the proper maintenance of the same.

Expenses of Administration.

The Commission prays that an amount of $8500 be placed in the estimates to provide for the expenses of administration, as follows:

Rent, heating, lighting, telephone and care of the Commission's office, No. 2, Cook Street Quebec	$ 1,000
Actual disbursements of Commissioners and staff for traveling expenses	1,600
Office supplies, including postage	200
Legal expenses, including registration and notarial fees	1,500
Salaries:	
Secretary, Mr. C. E. Gauvin	2,500
Clerk and Messenger	900
Contingent and unforeseen expenses	800
Total	$ 8,500

Conclusions.

In order that there be no delay in proceeding with the work next spring the Commission respectfully prays:

1. That measures be taken by the Government to remove the existing danger buildings" and rifle range from the Cove Fields and to transfer the said Cove Fields to the commission.
2. That the Government of Canada abandon, in favour of this Commission, such rights and interests as it may hold in the property commonly designated as "The Observatory Ground," subject to the necessary reservation for the Observatory Buildings, and that the Commission be authorized to assume the payment of the ground rent affecting this property or whatever portion of same which may be conveyed to this Commission by the Government of Canada or by the Government of the Province of Quebec for the purposes of the Park.
3. That authority be given to this Commission to acquire and hold the lands which may be transferred to it by the Government of the Province of Quebec for the purposes of the Park and to assume the payment of the ground rents affecting the lands thus transferred.
4. That authority be given to the Commission to acquire certain lots of land adjoining No. 4 Martello Tower, which lots respectively bear numbers 3755-188, 3755-189 and 3755-191 of the official cadastre of St. John's Ward of the City of Quebec, and also whatever portion of the cadastral lots numbers 3755-176, 3755-177, 3755-178 and 3755-179, on the south-east side of Ste. Cecile Street, with the buildings erected thereon, as this Commission may think advisable to purchase so as to give free and ample access to this Tower and to insure in the largest possible manner its protection against fire.
5. That the Commission be authorized to expend such sums as may be necessary to restore, maintain and preserve No. 4 Martello Tower:
6. That the moneys necessary to carry out the various recommendations contained in this report be granted to the Commission.

The whole respectfully submitted,

(Sgd.) J. GEO. GARNEAU,
Chairman.

(Sgd.) CHS. ED. GAUVIN,
Secretary.

(SEAL)

RETURN

[62]

TO AN ORDER OF THE HOUSE OF COMMONS, dated 7th December, 1910, for a copy of Sir John Thompson's memorandum on the question of the rights of fishing in the bays of Brittsh North America, prepared for the use of the British Plenipotentiaries at Washington in 1888, and a copy of the Treaty agreed to and approved by the President.

CHAS. MURPHY,
Secretary of State.

Ottawa, December 13, 1910.

Sir,—

With reference to an order of the House of Commons on motion of Mr. Foster for copy of Sir John Thompson's memorandum on the subject of the rights of fishing in the Bays of British North America prepared in 1888, and also copy of the Treaty agreed to by the United States on that occasion, I have the honour to enclose herewith copy of the Treaty in question, but as regards Sir John Thompson's memorandum, I regret to say that no copy of this document appears on the files of this, or so far as I am aware, of any public department.

The document in question was of a confidential character, and was treated as such at the time.

I have the honour to be, Sir,

Your obedient servant,

JOSEPH POPE,
Under Secretary of State
for External Affairs.

Thomas Mulvey, Esq., K.C.,
Under Secretary of State of Canada,
Ottawa.

Treaty between Great Britain and the United States, for the settlement of the Fishery Question on the Atlantic Coast of North America.—Signed at Washington, February 15, 1888.*

WHEREAS, differences have arisen concerning the interpretation of Article I of the Convention of the 20th October, 1818;* Her Majesty the Queen of the United Kingdom of Great Britain and Ireland, and the United States of America, being mutually desirous of removing all causes of misunderstanding in relation thereto, and of promoting friendly intercourse and good neighbourhood between the United States and the possessions of Her Majesty in North America, have resolved to conclude a Treaty to that end, and have named as their Plenipotentiaries, that is to say:

Her Majesty, the Queen of the United Kingdom of Great Britain and Ireland, the Right Honourable Joseph Chamberlain, M.P.; the Honourable Sir Lionel Sackville Sackville West, K. C. M. G., Her Britannic Majesty's Envoy Extraordinary and Minister Plenipotentiary to the United States of America; and Sir Charles Tupper, G. C. M. G., C. B., Minister of Finance of the Dominion of Canada;

And the President of the United States, Thomas F. Bayard, Secretary of State; William L. Putnam, of Maine; and James B. Angell, of Michigan.

Who, having communicated to each other their respective full powers, found in good and due form, have agreed upon the following Articles:—

ART. I. The High Contracting Parties agree to appoint a Mixed Commission to delimit, in the manner provided in this Treaty, the British waters, bays, creeks, and harbours of the coasts of Canada and of Newfoundland, as to which the United States, by Article I of the Convention of the 20th October, 1818, between Great Britain and the United States, renounced for ever any liberty to take, dry, or cure fish.

II. The Commission shall consist of two Commissioners to be named by Her Britannic Majesty, and of two Commissioners to be named by the President of the United States, without delay, after the exchange of ratifications of this Treaty.

The Commission shall meet and complete the delimitation as soon as possible thereafter.

In case of the death, absence, or incapacity of any Commissioner, or in the event of any Commissioner omitting or ceasing to act as such, the President of the United States or Her Britannic Majesty, respectively, shall forthwith name another person to act as Commissioner instead of the Commissioner originally named.

*This Treaty was not ratified, and it did not therefore come into force.

III. The delimitation referred to in Article I of this Treaty shall be marked upon British Admilality charts by a series of lines regularly numbered and duly described. The charts so marked shall, on the termination of the work of the Commission, be signed by the Commissioners in quadruplicate, three copies whereof shall be delivered to Her Majesty's Government, and one copy to the Secretary of State of the United States. The delimitation shall be made in the following manner, and shall be accepted by both the High Contracting Parties as applicable for all puropses under Article I of the Convention of the 20th October, 1818, between Great Britain and the United States.

The 3 marine miles mentioned in Article I of the Convention of the 20th October, 1818, shall be measured seaward from low watermark; but at every bay, creek or harbour, not otherwise specially provided for in this Treaty,, such 3 marine miles shall be measured seaward from a straight line drawn across the bay, creek, or harbour, in the part nearest the entrance at the first point where the width does not exceed ten marine miles.

IV. At or near the following bays the limits of exclusion under Article I of the Convention of the 20th October, 1818, at points more than 3 marine miles from low-water mark, shall be established by the following lines, namely:

At the Baie des Chaleurs the line from the light at Birch Point on Miscou Island to Macquereau Point light: at the Bay of Miramichi, the line from the light at Point Escuminac to the light on the eastern point of Tabusintac Gully; at Egmont Bay, in Prince Edward Island, the line from the light at Cape Egmont to the light at West Point; off St. Ann s Bay, in the Province of Nova Scotia, the line from Cape Smoke to the light at Point Aconi.

At Fortune Bay in Newfoundland, the line from Connaigre Head to the light on the south-easterly end of Brunet Island, thence to Fortune Head; at Sir Charles Hamilton Sound, the line from the south-east point of Cape Fogo to White Island, thence to the north end of Peckford Island, and from the south end of Peckford Island to the east headland of Ragged Harbour.

At or near the following bays the limits of exclusion shall be 3 marine miles seaward from the following lines, namely:

At or near Barrington Bay, in Nova Scotia, the line from the light on Stoddard Island to the light on the south point of Cape Sable, thence to the light at Bacarro Point; at Chedabucto and St. Peter's Bays, the line from Cranberry Island light to Green Island light, thence to Point Rouge; at Mira Bay, the line from the light on the east point of Scatari Island to the north-easterly point of Cape Morien; and at Placentia Bay, in Newfoundland, the line from Latine Point, on the eastern mainland shore, to the most southerly point of Red Island, thence by the most southerly point of Merasheen Island to the mainland.

Long Island and Bryer Island, at St. Mary's Bay, in Nova Scotia, shall, for the purpose of delimitation, to be taken as the coasts of such Bay.

V. Nothing in this Treaty shall be construed to include within the common waters any such interior portions of any bays, creeks, or harbours as cannot be reached from the sea without passing within the 3 marine miles mentioned in Article I of the Convention of the 20th October, 1818.

VI. The Commissioners shall, from time to time, report to each of the High Contracting Parties, such lines as they may have agreed upon, numbered, described, and marked as herein provided, with quadruplicate charts thereof; which lines so reported shall forthwith from time to time be simultaneously proclaimed by the High Contracting Parties, and be binding after two months from such proclamation.

VII. Any disagreement of the Commissioners shall forthwith be referred to an umpire selected by Her Britannic Majesty's Minister at Washington and the Secretary of State of the United States; and his decision shall be final.

VIII. Each of the High Contracting Parties shall pay its own Commissioners and officers. All other expenses jointly incurred, in connection with the performance of the work, including compensation to the umpire, shall be paid by the High Contracting Parties in equal moieties.

IX. Nothing in this Treaty shall interrupt or affect the free navigation of the Strait of Canso by fishing-vessels of the United States.

X. United States fishing-vessels entering the bays or harbours referred to in Article I of this Treaty shall conform to harbour regulations common to them and to fishing-vessels of Canada or of Newfoundland.

They need not report, enter, or clear, when putting into such bays or harbours for shelter or repairing damages, nor when putting into the same, outside the limits of established ports of entry, for the purpose of purchasing wood or of obtaining water; except that any such vessel remaining more than 24 hours, exclusive of Sundays and legal holidays, within any such port, or communicating with the shore therein, may be required to report, enter, or clear; and no vessel shall be excused hereby from giving due information to boarding officers.

They shall not be liable in such bays or harbours for compulsory pilotage; nor, when therein, for the purpose of shelter, of repairing damages, of purchasing wood, or of obtaining water shall they be liable for harbour dues, tonnage dues, buoy dues, light dues or other similar dues; but this enumeration shall not permit other charges inconsistent with the enjoyment of the liberties reserved or secured by the Convention of the 20th October, 1818.

XI. United States' fishing-vessels entering the ports, bays, and harbours of the eastern and north-eastern coasts of Canada or of the coasts of Newfoundland under stress of weather or other casualty may unload, reload, tranship, or

sell, subject to customs laws and regulations, all fish on board, when such unloading, transhipment, or sale is made necessary as incidental to repairs, and may replenish outfits, provisions and supplies, damaged or lost by disaster; and in case of death or sickness, shall be allowed all needful facilities, including the shipping of crews.

Licences to purchase in established ports of entry of the aforesaid coasts of Canada or of Newfoundland, for the homeward voyage, such provisions and supplies as are ordinarily sold to trading vessels, shall be granted to United States' fishing-vessels in such ports, promptly upon application and without charge; and such vessels having obtained licences in the manner aforesaid, shall also be accorded upon all occasions, such facilities for the purchase of casual or needful provision and supplies as are ordinarily granted to trading vessels; but such provisions or supplies shall not be obtained by barter nor purchased for resale or traffic.

XII. Fishing-vessels of Canada and Newfoundland shall have on the Atlantic coasts of the United States all the privileges reserved and secured by this Treaty to United States' trading-vessels in the aforesaid waters of Canada and Newfoundland.

XIII. The Secretary of the Treasury of the United States shall make regulations providing for the conspicuous exhibition by every United States' fishing vessel of its official number on each bow; and any such vessel required by law to have an official number, and failing to comply with such regulations, shall not be entitled to the licences provided for in this Treaty.

Such regulations shall be communicated to Her Majesty's Government previously to their taking effect.

XIV. The penalties for unlawfully fishing in waters, bays, creeks and harbours, referred to in Article I. of this Treaty, may extend to forfeiture of the boat or vessel and appurtenances, and also of the supplies and cargo aboard when the offence is committed; and for preparing in such waters to unlawfully fish therein, penalties shall be fixed by the Court, not to exceed those for unlawfully fishing; or for any other violation of the laws of Great Britain, Canada or Newfoundland, relating to the right of fishing in such waters, bays, creeks or harbours, penalties shall be fixed by the Court, not exceeding in all 3 dollars for every ton of the boat or vessel concerned. The boat or vessel may be holden for such penalties and forfeitures.

The proceedings shall be summary and as inexpensive as practicable. The trial (except on appeal) shall be at the place of detention, unless the Judge shall on request of the defence, order it to be held at some other place adjudged by him more convenient. Security for costs shall not be required of the defence except when bail is offered. Reasonable bail shall be accepted. There shall be proper appeals available to the defence only, and the evidence at the trial may be used on appeal.

Judgments of forfeiture shall be reviewed by the Governor General of Canada in Council, or by the Governor in Council of Newfoundland, before the same are executed.

XV. Whenever the United States shall remove the duty from fish-oil, whale-oil, seal-oil, and fish of all kinds, (except fish preserved in oil), being the produce of fisheries carried on by the fishermen of Canada and of Newfoundland, including Labrador, as well as from the usual and necessary casks, barrels, kegs, cans and other usual and necessary coverings containing the products above mentioned, the like products, being the product of fisheries carried on by the fishermen of the United States, as well as the usual and necessary coverings of the same, as above described, shall be admitted free of duty into the Dominion of Canada and Newfoundland.

And upon such removal of duties, and while the aforesaid articles are allowed to be brought into the United States by British subjects, without duty being reimposed thereon, the privilege of entering the ports, bays and harbours of the aforesaid coasts of Canada and of Newfoundland shall be accorded to United States' fishing-vessels by annual licences, free of charge, for the following purposes, namely:—

1. The purchase of provisions, bait, ice, seines, lines, and all other supplies and outfits;

2. Transhipment of catch, for transport by any means of conveyance.

3. Shipping of crews.

Supplies shall not be obtained by barter, but bait may be so obtained.

The like privileges shall be continued or given to fishing-vessels of Canada and of Newfoundland on the Atlantic coasts of the United States.

XVI. This Treaty shall be ratified by Her Britannic Majesty, having received the assent of the Parliament of Canada and of the Legislature of Newfoundland; * and by the President of the United States, by and with the advice and consent of the Senate; and the ratifications shall be exchanged at Washington as soon as possible.

In faith whereof, we, the respective Plenipotentiaries, have signed this Treaty, and have hereunto affixed our seals.

Done in duplicate, at Washington, this 15th day of February, in the year of our Lord 1888.

(L.S.) J. CHAMBERLAIN.
(L.S.) L. S. SACKVILLE WEST.
(L.S.) CHARLES TUPPER.
(L.S.) T. F. BAYARD.
(L.S.) WILLIAM L. PUTNAM.
(L.S.) JAMES B. ANGELL.

* The Treaty was assented to by the Government of Canada, May 4, 1888 (see page 550), and by the Government of Newfoundland, May 9, 1888 (see page 95), but it was not ratified by the Senate of the United States.

Protocol, dated February 15, 1888.

THE Treaty having been signed, the British Plenipotentiaries desire to state that they have been considering the position which will be created by the immediate commencement of the fishing season before this treaty can possibly be ratified by the Senate of the United States, by the Parliament of Canada, and Legislature of Newfoundland.

In the absence of such ratification the old conditions which have given rise to so much friction and irritation might be revived, and might interfere with the unprejudiced consideration of the Treaty by the legislative bodies concerned.

Under these circumstances, and with the further object of affording evidence of their anxious desire to promote good feeling and to remove all possible subjects of controversy, the British Plenipotentiaries are ready to make the following temporary arrangements for a period not exceeding two years, in order to afford a **modus vivendi** pending the ratification of the Treaty:

1. For a period not exceeding two years from the present date, the privilege of entering the bays and harbours of the Atlantic coasts of Canada and Newfoundland shall be granted to United States' fishing-vessels by annual licenses at a fee of 1½ dollars per ton, for the following purposes:

The purchase of bait, ice, seines, lines, and all other supplies and outfits.

Transhipment of catch and shipping of crews.

2. If, during the continuance of this arrangement, the United States should remove the duties on fish, fish-oil, whale and seal-oil (and their coverings, packages, etc.) the said licences shall be issued free of charge.

3. United States' fishing-vessels entering the bays and harbours of the Atlantic coasts of Canada or of Newfoundland for any of the four purposes mentioned in Article I. of the Convention of the 20th October, 1818, and not remaining therein more than 24 hours, shall not be required to enter or clear at the custom-house, providing that they do not communicate with the shore.

4. Forfeiture to be exacted only for the offences of fishing or preparing to fish in territorial waters.

5. This arrangement to take effect as soon as the necessary measures can be completed by the Colonial authorities.

Washington, February 15, 1888.

J. CHAMBERLAIN..

L. S. SACKVILLE WEST.

CHARLES TUPPER.

Protocol, dated February 15, 1888.

THE American Plenipotentiaries having received the communication of the British Plenipotentiaries of this date conveying their plan for the administration to be observed by the Governments of Canada and Newfoundland in respect of their fisheries during the period which may be requisite for the consideration by the Senate of the Treaty this day signed, and the enactment of the legislation by the respective Governments therein proposed, desire to express their satisfaction with this manifestation of an intention on the part of the British Plenipotentiaries, by the means referred to, to maintain the relations of good neighbourhood between the British possessions in North America and the United States; and they will convey the communication of the British Plenipotentiaries to the President of the United States, with the recommendation that the same may be by him made known to the Senate, for its information, together with the Treaty, when the latter is submitted to that body for ratification.

Washington, February 15, 1888.

T. F. BAYARD.
WILLIAM L. PUTNAM.
JAMES B. ANGELL.

RETURN

[63]

To an Address to His Excellency the Governor General for a copy of any memorials, correspondence, etc., between His Excellency the Governor General and the Colonial Office, or between any member of the Government, and the Foreign Consuls General in Canada, relative to the status of the latter, at official functions, such as Vice Regal Drawing Room.

CHAS. MURPHY,
Secretary of State.

The Officer Administering
the Government of
Canada.

Downing Street,
1st June, 1906.

Sir.—I have had recently under my consideration points which have arisen in connection with the position and treatment of Foreign Consuls in the Colonies, and, after communication with the Secretary of State for Foreign Affairs, I have thought it proper to lay down certain principles for the guidance of Governors. You will understand that it is not expected that they can be applied in Colonies where a different practice has been established, but it is my desire that Colonial Governors should look to them as a guide in future when opportunities occur of applying them without unnecessary friction.

2. No general instructions to Colonial Governors respecting the position and treatment of Consuls appear to have been issued since a date nearly forty years ago, when it was intimated that if in any Colony precedence was, as a matter of courtesy, already accorded to the Foreign Consular Body, no alteration should be made, with a view of assimilating the practice to that in force in this country, without reference to the Secretary of State. It was observed, however, that Foreign Consuls in England have no claim of precedency, and are treated like any other Foreigners resident in England. This principle, I may now observe, equally extends to the Colonies, and it is not desirable that any instructions should be given tending to

recognise the principle of according precedence to the Foreign Consular Body. In 1863 a claim was advanced by the Consular Body at Sydney to be admitted to the entree at the Governor's levee on the occasion of the Sovereign's Birthday, and it was then stated that the rule of Her Majesty's Court was, that as Consuls-General and Consuls had no diplomatic character, and were not visitors of the Court, they fell into the class of Foreigners resident in England and went to the general entree and were presented in the general circle.

3. As regards privileges or exemptions, it was held, on a claim advanced by the Spanish Consul at Brisbane in 1856, that there were no privileges to which Foreign Consuls were strictly or legally entitled, as a right, in Great Britain or in any of her Colonies; that the English law considered them amenable to civil and criminal jurisdiction, did not give them, or allow them, any legal privileges whatever, and could hardly be said to recognise them in their official character; and that such privileges or exemptions as they might enjoy were conceded to them (if at all) either by the Executive or Local Authorities at their discretion or by usage and courtesy.

4. This decision should be carefully borne in mind as it would prove in the highest degree inconvenient if in British Colonies, Consuls of Foreign Powers should be permitted to acquire a claim to the privileges or immunities of diplomatic agents, or to assume in any other respect a footing different from that which they hold in the United Kingdom. Recent experiences have shown that this possible danger is a real one, and should be strictly guarded against.

5. In the correspondence which has given rise to the present despatch His Majesty's Government has been asked for instructions on several points, and I deal with these in the order in which they have been raised.

(a) As to ceremonials and formal courtesies. From the earlier part of this despatch it will be clear that the Consuls are not entitled to be specially received at public functions, and that they should not be given any precedence over local officials. In regard to this point, I may observe that, even if it were not objectionable on other grounds it would be impossible to lay down general rules as to precedence over officials, having regard to the varying importance in different Colonies of what is nominally the same office, and if special rules were laid down in each case they would give rise to endless claims from Consuls founded on the practice elsewhere which was most favourable to their contentions. The preceding considerations need not, however, prevent the Governor from specially receiving the Consuls, as a body, on certain occasions such as on the King's Birthday or on his own first arrival in the Colony, as an act of courtesy and not as a right, if this practice, which has been followed at the Cape since 1893, should be pressed upon him.

As regards visits, it has already been observed that Consuls-General and Consuls are not visitors of the Court, and it follows that they do not "visit" the Governor, who is the King's representative in the Colony. If they wait on the Governor, on any other occasion than for the transaction of consular business, they do so on the same footing as any prominent inhabitant of the Colony, and their visit does not require to be formally returned on the Governor's behalf.

(b) With regard to the transaction of public business, Consuls should, under no circumstances, be permitted to approach the Local Governments except on matters connected with the personal welfare of their countrymen as individuals, and if they should make any representations on general political questions they should in all cases be required to communicate them to their respective Governments, to be dealt with through the proper diplomatic channels. The only legitimate functions of a Foreign Consul in relation to a Colonial Administration are those connected with the welfare of his nationals as individuals, and, therefore, any questions with regard to trade and commerce which might affect the general commercial policy of the Colony would fall into the category of those which must be discussed through the respective Foreign Offices.

(c) From what has already been said, it follows that no difference should be made in treatment, as between "consuls de carriere," and other consular officers.

(d) As regards the practice of appointing a Consul-General with local Consuls subordinate to him all consular officers require recognition by the respective local Governments before they can enter on their functions, although such recognition is only withheld in the case of some valid objection to the appointment. His Majesty's Government would not interfere with the arrangements made by Foreign Governments for the performance of consular duties, and if, for example, a Foreign Government appointed a Consul-General for South Africa, it would be open to that official in virtue of his exequatur to communicate (in the exercise of his duties as above defined) with all Governors in South Africa, and if the same Government appointed, in addition, a Consul in a South African Colony where the Consul-General was not resident, His Majesty's Government would not require that consular communications with the Governor of that Colony should be made by the local Consul and not by the Consul-General, though they might reasonably require that communications connected with any one Colony should be with the occupant of one consular post only who would be designated by the Foreign Government concerned.

ELGIN.

RETURN

(65)

To an Address of the House of Commons, dated the 9th December, 1910, calling for a copy of all Orders in Council, correspondence, papers, maps or other documents which passed between the Government of Canada or any member thereof, and the Government of Quebec, or any member thereof, or any other parties on their behalf, or between the Government of Canada and the Government of Ontario, or any members thereof, regarding the extension of the boundaries of the Province of Quebec, as set forth in an Order in Council dated 8th July, 1896, establishing a Conventional Boundary, therein specified. And also any correspondence, papers, documents, &c., that may have passed between the aforesaid Governments or members thereof, relative to the passing of an Act to confirm and ratify the aforesaid Conventional Boundary which was passed in 1898.

CHAS. MURPHY,
Secretary of State.

Re BOUNDARIES OF QUEBEC:

See Sessional Papers, No. 71, of 1892; No. 43, of 1893, and the following papers:—

(P.C. 637 J.)

Ottawa, 2nd February, 1895.

To His Excellency

The Governor General in Council.

Upon the reference from Council, No. 637 J., dated the 9th instant, of a copy of a despatch from His Honour the Lieutenant Governor of Quebec, transmitting a copy of a report of a Committee of his Executive Council regarding the settlement of the northern and north-easterly boundary of the Province, the undersigned has the honour to state that the surveyor who made the exploration which is referred to in the latter part of the Memorandum of the Executive Council has not yet completed his report: but so soon as it is handed in it will receive immediate and careful consideration, and the Government of the Province will be duly advised of the conclusions arrived at in the premises. He recommends that the Secretary of State be requested to transmit a copy of the Order which may be based on this Memorandum to His Honour the Lieutenant Governor of Quebec for the information of the Executive Council.

Respectfully submitted,

(Sd.) T. MAYNE DALY,
Minister of the Interior.

HOTEL DU GOUVERNEMENT.

QUÉBEC, 6 décembre 1894.

MONSIEUR,—J'ai l'honneur de vous transmettre ci-joint, copie d'un arrêté en Conseil en date du 30 novembre dernier, au sujet de la frontière nord et nord-est, de la province de Québec, et de vous prier de vouloir soumettre ce document a Son Excellence le Gouverneur général en Conseil.

J'ai l'honneur, &c.,

(Sd.) J. A. CHAPLEAU,

Lieutenant Governeur.

L'honorable Secrétaire d'Etat,

Ottawa.

COPY *of a Report of a Committee of the Honourable the Executive Council, dated the 21st November, 1894. Approved by the Lieutenant Governor the 30th November, 1894.*

RESPECTING THE SETTLEMENT OF THE NORTH AND THE NORTH-EASTERLY BOUNDARY OF THE PROVINCE OF QUEBEC.

The Honourable the Commisisoner of Crown Lands, in a report dated the 21st of November instant, (1894), sets forth: that the important question of the North and North-eastern Boundary of the Province of Quebec, although submitted on various occasions to the Federal authorities at Ottawa, remains up to the present unsettled, notwithstanding the fact that the pretentions of the Province of Ontario, for an analogous extension of territory, have been recognized by the Parliament of Canada and the Imperial Parliament.

That as a matter of justice and right, the Province of Quebec is fully justified in persisting as it does persist, in the views embodied in the resolutions of the Quebec Legislative Assembly of 1886, having reference thereto, copy of which has already been transmitted to His Excellency the Governor General in Council, and in claiming, as it does claim, for reasons similar or somewhat similar to those successfully urged by the Province of Ontario, for an extension to its boundaries, all the territory situate north of the height of land, as far as the northerly limits held by the French Government, at the time of the negotiations preliminary to the signature of the treaty of Utrecht in 1713, and more particularly the territory defined in the aforesaid resolutions, as follows:—

'All the country bounded on the west by a prolongation of the present boundary line between Ontario and Quebec to the south shore of James Bay, and by the shore line of this bay as far as the mouth of East Main River, on the north by the right bank of East Main River from its mouth to its source, thence by a line drawn to the northernmost waters of the Grand River Esquimaux, Ashuanipi or Hamilton, and by the left bank of this river to its mouth in Rigolet Bay, (Hamilton's Inlet), on the east and north-east by the meridian of the easternmost point of the source of the River St. Paul or Little Esquimaux, and again on the east by this same river to the fifty-second degree of north latitude, following this parallel to its intersection by the meridian of Anse au Blanc Sablon, the present recognized eastern boundary of this province.'

That the lack of information relating to this extent of country is one of the explanations given for the delays which have occurred in the settlement of this just claim;

That within the last three years exhaustive explorations have been effected by competent officers of the Geological Commission of Canada, through the principal waters system of that region and that the Government of Canada is no doubt at present in possession of the necessary data regarding the geography and resources of that country.

That these studies being now completed, the necessary legislation can be adopted by the Parliament of Canada and the Honourable Commissioner recommends that a despatch be sent through His Honour the Lieutenant Governor to the Honourable the Secretary of State for Canada, praying that the Government of Canada submit at the next session of Parliament the adoption of a measure sanctioning the North Eastern Boundary of the Province of Quebec as laid down in the Resolutions of the Quebec Legislative Assembly of 1886 above cited.

Certified,

(Sd.) GUSTAVE GRENIER,
Clerk, Executive Council.

(P.C. 2623)

CERTIFIED *Copy of a Report of the Committee of the Privy Council, Approved by His Excellency the Governor General on the 8th July, 1896.*

On a Memorandum dated 6th July, 1896, from the Minister of the Interior, submitting the annexed Report from the Deputy Minister of the Interior, having relation to the subject of the Northern, North-western and North-eastern boundaries of the Province of Quebec, and containing a proposed description of the same.

The Committee on the recommendation of the Minister of the Interior advise that the said report be approved, and that the necessary steps be taken to obtain the acceptance by the Government of Quebec and the ratification by Parliament of the proposed description of the North-western, Northern and North-eastern Boundaries of the Province of Quebec therein contained.

RODOLPHE BOUDREAU,
Clerk of the Privy Council.

DEPARTMENT OF THE INTERIOR,

OTTAWA, 29th January, 1896.

(P.C. 2623*a*)

The Hon. T. MAYNE DALY,
Minister of the Interior.

SIR,—I have the honour to report that I have, in accordance with your request, given careful consideration to the various references which have been made from Council of despatches from His Honour the Lieutenant Governor of Quebec, having relation to the subject of the Northern, North-western and North-eastern boundaries of that Province.

The views of the Provincial authorities as to what these boundaries should be are set forth in a report, dated 4th June, 1886, made by a select committee of the Legislative Assembly 'to consider the question of the Northern and North-eastern limits of the Province of Quebec, and the necessary measures to be taken in order that such limits do include the territories to which it is entitled by establishing and defining such rights.' The correspondence which has passed between the Province

and the Government of Canada in this relation has been laid before Parliament, and shows in effect that what the Province contends for is the continuation to the shore of James Bay of the due north line from the head of Lake Temiscamingue which already constitutes the Eastern boundary of the Province of Ontario; thence along the shores of James Bay to the mouth of the East Main River, and along that River to its source; thence by a right line to the most northerly waters of the Ashuanipi or Hamilton River; thence descending that stream until it intersects the boundary of Newfoundland territory in Labrador; and finally following the last named boundary to Blanc Sablon on the north shore of the Gulf of St. Lawrence.

This proposal, with the correspondence arising out of it, was referred to the Department of the Interior in December, 1889. I then reported that next to nothing was known about the East Main and Hamilton Rivers; that like all other rivers they undoubtedly had several sources and branches and that before they could be adopted as a boundary it would be necessary to determine in each case which of the branches is to be adopted as the dividing line. It was then regarded as possible that some of the branches of both streams might extend far away to the north, and include territory which it was not contemplated by either Government should be included in the Province of Quebec. Even if both Governments were agreed as to the propriety of adopting the Legislative Assembly's suggestion on its merits, the branches and sources of the respective rivers to be adopted for the purposes of the boundary, and to be connected by a right line, should first be agreed upon.

With a view to the acquisition of as much as possible of the information which was thus indicated as being necessary, Mr. William Ogilvie was despatched to James Bay in the spring of 1890. His survey settled definitely and affirmatively a point upon which up to that time there was more or less doubt; that is, as to whether the Temiscamingue meridian, although actually made the Eastern boundary of the Province of Ontario by an Act of the Imperial Parliament on the assumption that it intersected James Bay at the point indicated upon all existing maps, really did touch the waters of the Bay at all. Mr. Ogilvie fixed the point at which the Temiscamingue line reaches the waters of the Bay, made a reliable survey of the coast line from that point to the mouth of the East Main River, and determined the latitude of the mouth of the River. In 1892 Mr. A. P. Low of the Geological Survey, connected by a micrometer survey Ogilvie's station at the mouth of the East Main River with Lake Mistassini, 308 miles of the East Main River being included in this survey. Again in 1893 Mr. Low continued his survey from the point on the river which he reached the previous season up to the head of Patamik Lake, from which he went to Ungava Bay by the Koksoak or Ungava River, and from thence to Hamilton Inlet, where he spent the winter. In the spring of 1894 he surveyed the Hamilton River from Goose Bay to a point some distance up the Ashuanipi branch, and returned to that section last year with the object of obtaining further particulars respecting the country about the head waters of the Manicougan River.

The Government are now in possession of sufficient information to show that the proposal made by the Government of Quebec in 1886 is a practicable one.

I do not contend that the boundary proposed is a legal boundary, but on the contrary admit that it is a conventional one. The true limit of the Province of Quebec on the North would probably be the boundary between New France and the territories of Great Britain on the northern part of the continent. There was some difference of opinion between France and England as to where the boundary should be, and the commissioners appointed to decide the question never reported. Even if that boundary had been finally established it could not now be adhered to, because in the interval, after an arrangement and a re-arrangement, the Imperial Government finally detached from the Province of Quebec and placed under the jurisdiction of Newfoundland the strip along the Atlantic coast extending from Anse Sablon to Hudson Strait described by 'Letters Patent' dated 28th March, 1876, as follows: "The Coast of "Labrador from the entrance of Hudson's Strait to a line to be drawn due north

"and south from Anse Sablon on the said coast to the 52nd degree of north latitude, "and all the Islands adjacent to that part of the Coast of Labrador."

What therefore is now aimed at is a conventional line which will also be convenient and easily ascertained, and it is believed that in the description appended to this memorandum that aim has been attained, the only portion of the lines it describes which would appear to require to be established by any further actual survey being the right line connecting the waters of the East Main River with the waters of the Ashuanipi. The suggestion made by the Hon. David Mills when this matter was discussed in the House of Commons in 1893 was that the Rupert River should be the boundary, his contention being that the territory lying to the south of it would be equal in extent and it might be persumed superior in value and importance to the territory which the Province of Quebec would yield to Canada north of that river. But the Rupert River would serve as a boundary only in respect of the territory lying between Lake Misstassini and James Bay, and there would be a great tract of country lying between Lake Mistassini and the Hamilton River which would have to be connected by an artificial line, the cost of surveying which it is impossible to estimate, but which would in any event be very great. All that is knowwn about that part of the country, including the exploration of Mr. Lowe, would indicate that neither its soil nor its climate make it suitable for agricultural or pastoral purposes; that its supply of timber is of no great value; and there would appear to be no indications from its geological structure of much available mineral wealth. The conventional boundary proposed has the advantage of being for five-sixths of its distance a natural boundary which needs no surveying to establish it, and it gives to the Province of Quebec not any more, and probably a good deal less territory than it would have obtained had the Commissioners appointed to define the boundary between the French and British possessions in the Northern part of the continent arrived at a decision. Moreover it is substantially the proposition of the Province itself. The Provincial Government and Legislature originally described the territory which they thought should be included as lying south of the East Main River followed to its source, the last mentioned point to be connected with the most northerly source of the Hamilton River. At that time if I am not very much mistaken, the sources of both rivers were assumed to be situated geographically, in relative proximity to each other—a theory which is now no longer entertained. It would take many years of exploration and the expenditure of a good deal of money to settle what are the true sources of the East Main and the Hamilton Rivers respectively, but as I read the correspondence which has passed upon the subject, the boundary line as hereinafter described will meet the views of the authorities of the Province to all intents and purposes. I therefore respectfully submit it for your consideration, and recommend that the necessary steps be taken to obtain its acceptance by the Government of Quebec and its ratification by the Parliament of Canada.

Proposed description of the North Western, Northern and North Eastern Boundaries of Quebec:

Commencing at the head of Lake Temiscamingue thence along the province of Ontario due North to the shore of the part of Hudson Bay commonly known as James Bay, and thence north-easterly, following upon the said shore to the mouth of the East Main River, and thence easterly ascending along the middle of the said river up to the confluence of the Branch thereof flowing from Patamisk Lake, and thence ascending along the middle of the said branch up to Patamisk Lake, and thence along the middle of the said Lake to the most northerly point thereof, the said point being about fifteen miles south from the Hudson's Bay Company's post on Lake Nichigun and approximately in Latitude fifty-two degrees and fifty-five minutes north, and longitude seventy degrees and forty-two minutes west of Greenwich; thence due east along the parallel of latitude of the said point to the intersection of the river discharging the waters of Lake Ashuanipi, which river is known under the names of Hamilton or Ashuanipi or Great Esquimaux River, and thence descending

along the middle of the said river through Menihek, Marble, Astray and Dyke Lakes to the most southerly outlet of Dyke Lake, and thence along the middle of the said outlet to Birch Lake, and thence along the middle of Birch and Sandgirt Lakes to the most southerly outlet of Sandgirt Lake, and thence along the middle of the southern channel of the Hamilton River to Flour Lake, and thence along the middle of Flour Lake to its outlet, and thence along the middle of Hamilton River to the Bay du Rigolet or Hamilton Inlet, and thence easterly along the middle of the said bay or inlet until it strikes the Westerly Boundary of the territory under the jurisdiction of Newfoundland, and thence southerly along said boundary to the point where it strikes the north shore of the Anse Sablon in the Gulf of St. Lawrence, the said boundary being shown in red as far as Hamilton Inlet on the map hereto attached.

I have the honour to be,

Sir,

Your obedient servant,

(Sd.) A. M. BURGESS,
Deputy Minister of the Interior.

CERTIFIED *copy of a Report of the Committee of the Privy Council, approved by His Excellency the Governor General on the 25th January, 1897.*

The Committee of the Privy Council have had under consideration a despatch hereto attached, dated 21st November, 1896, from His Honour the Lieutenant Governor of Quebec, transmitting a copy of a report of the Executive Council accepting the rescription of the Northern, North-Eastern and North-Western boundaries of the Province of Quebec, proposed by the Minute of Council dated the 8th of July last.

The Minister of the Interior to whom the matter was referred states that by Section 3 of the British North America Act, 1871 (Imperial Act 34-35 Victoria Chapter 28), it is provided that the Parliament of Canada may, from time to time, with the consent of the Legislature of any Province, increase, diminish or otherwise alter the limits of such Province, upon such terms and conditions as may be agreed to by the said Legislature, and may, with the like consent, make provision respecting the effect and operation of any such increase or diminution or alteration of territory in relation to any Province offected thereby.

The Minister further states that the Legislature of the Province must consent to the proposed boundary so far as it increases, diminishes or otherwise alters the limits of the Province, and must agree as to the terms and condition and consent to any provision to be made as to the effect and operation of the change.

The Minister considers it proper that the attention of His Honour the Lieutenant Governor of Quebec should be called to the provisions of the Statute, and that he should be asked to furnish Your Excellency in Council with any views or suggestions his government may think proper to offer as to the form and terms of the necessary legislation.

The Minister observes that in this connection reference may be made to the Acts enlarging the boundaries of Manitoba as precedents to some extent for legislation of this kind, viz:—40 Victoria, Chapter 6, and 44 Victoria, Chapter 14. The Statutes of Manitoba consenting to the changes made by these Acts are 37 Victoria Chapter 2, and 44 Victoria, Chapter 1. (See Revised Statutes of Manitoba, Chapter 11).

The Committee advise that a certified copy of this Minute be forwarded to His Honour the Lieutenant Governor of the Province of Quebec.

All which is respectfully submitted for Your Excellency's approval.

RODOLPHE BOUDREAU
Clerk of the Privy Council.

HOTEL DU GOUVERNEMENT
QUÉBEC, 23 novembre, 1896.

MONSIEUR.—J'ai l'honneur d'accuser reception de votre dépêche du 10 courant, (Lettre No. 4881 dossier No. 4679) transmettant une copie certifiée d'un Arrêté de Son Excellence le Gouverneur Général en Conseil du 8 juillet dernier et du plan qui l'accompagne touchant les frontières Nord, Nord Est et Nord Ouest de la Province de Québec.

En réponse je m'empresse de vous transmettre ci-annexée, copie d'un Arrêté de mon Conseil Exécutif en date du 14 Novembre courant par lequel mon Gouvernement accepte les bornes désignées dans le rapport du député Ministre de l'Intérieur en date du 29 janvier, 1896 et mentionnées dans l'Arrêté en Conseil du 8 juillet 1896.

J'ai l'honneur, etc.,

J. A. CHAPLEAU,
Lieutenant Gouverneur.

L'Honorable Secrétaire d'Etat, Ottawa.

COPIE *du Rapport d'un Comité de l'Honorable Conseil Executif, en date du 13 novembre 1896, apprové par le Lieutenant Gouverneur le 14 novembre 1896.*

CONCERNING BOUNDARIES OF THE PROVINCE OF QUEBEC.

The Honourable the Premier, with a memorandum dated the thirteenth of November instant, (1896), submits a despatch from the Honourable the Secretary of State, Ottawa of the 10th November instant, transmitting a copy of an Order of His Excellency the Governor General in Council, of the 8th July last, having relation to the subject of the Northern, North-Western and North-Eastern boundaries of the Province of Quebec, and containing a proposed description of the same.

The Honourable the Premier recommends that a despatch be forwarded to the Honourable the Secretary of State, Ottawa, acknowledging receipt of the Order in Council above mentioned, and accepting the description of the Northern, North-Eastern and North-Western boundaries of the Province of Quebec contained in the report of the Deputy Minister of the Interior, dated the 29th January, 1896, and mentioned in the said Order of His Excellency the Governor General in Council of the 8th July, 1896.

Certifié

(Signé) GUSTAVE GRENIER
Greffier Conseil Executif.

CERTIFIED *copy of a Report of the Committee of the Privy Council, approved by His Excellency the Governor General on the 29th April,* 1897.

The Committee of the Privy Council have had under consideration a Despatch, hereto attached, dated 31st March, 1897, from the Lieutenant Governor of Quebec stating in relation to the proposed settlement of the Northern, North-

eastern boundaries of that Province, that his Government will not fail to introduce at the next session of the Legislature, a measure embodying the formal consent required by section 3 of the Imperial Act 34-35 Victoria, Chapter 28.

The Minister of Justice to whom the matter was referred, reports that the Act of the Quebec Legislature should precede the Dominion Act, that Section 3 of the British North America Act is as follows:—

"The Parliament of Canada may from time to time, with the consent of the "Legislature of any Province of the said Dominion, increase, diminish or other- "wise alter the limits of such Province, upon such terms and conditions as may be "agreed to by the said Legislature, and may, with the like consent, make pro- "vision respecting the effect and operation of any such increase or diminution or "alteration of territory in relation to any Province affected thereby."

The Jurisdiction of the Parliament of Canada is, therefore, dependent upon the consent of the Provincial Legislature, which should be first given.

The Minister recommends that the Provincial Government be requested to forward a draft of the intended measure expressing such consent.

The Committee advise that a certified copy of this Minute if approved, be transmitted to the Lieutenant Governor of the Province of Quebec.

RODOLPHE BOUDREAU,
Clerk of the Privy Council.

GOVERNMENT HOUSE,
QUEBEC, 31st March, 1897.

SIR,—By your despatch of the 28th January, you transmitted to me a copy of an Order of His Excellency the Governor General in Council of the 25th of the same month, regarding the northern, northeastern, and northwestern boundaries of the province of Quebec, and you specially invited my attention to the provisions of Section 3 of the Imperial Act 34 and 35 Victoria, Cap. 28. You were also good enough to request me to make known to His Excellency the opinion of my advisers regarding the legislation which should be adopted as a conclusion to the negotiations that had been carried on between the Federal government and the government of the province of Quebec on the subject of the said boundaries.

Although the Minute of the Privy Council of the 8th July, 1896, transmitted with your despatch of the 10 November following was placed in possession of my government at a time when their attention was particularly required for the preparation of the work of the session of the Legislature (opened on the 17th November) my ministers did not wish to delay an acceptance of the delimitation of the frontier described in that document, and they formulated such acceptance by an Order in Council bearing date the 14th November, 1896, which I transmitted to His Excellency the Governor General with my despatch of the 23rd of the same month.

By your despatch of the 28th January last you transmitted me a minute of the Privy Council of the 25th of the same month in which it is set forth that consent to the changing of the boundaries in question should be given by the Legislature of the Province. My advisers having referred to the English text of the Imperial Act 34-35 Victoria, Cap. 28, have found that there was an omission in the French translation of Section 3 of the same Act, consulted by them in the first instance. The English version of this section 3 thus begins:—

"The Parliament of Canada may from time to time with the consent of the Legislature of any province of the said Dominion, increase, diminish, or otherwise alter the limits of such province," whereas the French version reads as follows:— "With the consent of any province of the said Dominion, the Parliament of Canada

shall have power from time to time, to increase, diminish, or otherwise alter the limits of such Province."

The words "of the Legislature" have, then, been left out in this latter version, which is only a translation of the original text in English.

According to the original text, it is plain that the acceptance by Order in Council is not enough, and you may assure His Excellency the Governor General that my government will not fail to introduce at next session of the Legislature a measure embodying the formal consent required by the said section 3 of the Imperial Act 34-35 Vic., Cap. 28. As to the opinion which you have been so good as to request me to make known to His Excellency touching the legislation to be adopted on the subject of the aforesaid northern, north-eastern and north-western boundaries of the Province, it is the advice of my ministers that the Federal Legislation, just as the Provincial Legislation on this subject should in nowise depart from what has been stipulated by the two Minutes of Council above mentioned, namely, the Minute of the Privy Council of the 8th July, 1896, and the Minute of the Executive Council of the 14th November of the same year.

The Act of this Province, 38 Victoria, Cap. 6, (Article 59 of the Revised Statutes of he Province of Quebec) concerning the boundary line between Ontario and Quebec may serve as a model in the matter.

I have the honour to be, SIR, Your obedient servant,

J. A. CHAPLEAU,
Lieutenant-Governor.

The Honourable,

R. W. SCOTT,

Secretary of State,
Ottawa.

CERTIFIED *copy of a Report of the Committee of the Privy Council, approved by His Excellency the Governor General on the 10th December, 1897.*

The Committee of the Privy Council have had under consideration a Despatch, hereto annexed, dated 25th October, 1897, from His Honour the Lieutenant Governor of the Province of Quebec, transmitting a draft bill expressing the consent of the Provincial Legislature of the said Province of Quebec, to the proposed legislation declaring the Northwestern, Northern and Northeastern boundaries of the said Province.

The Minister of Justice, to whom the said Despatch was referred, states that he finds the said draft bill to be in point of form proper and sufficient for the purpose intended.

The Minister desires further to acquaint Your Excellency that a Report has been obtained by the Department of Justice from the Department of the Interior of the result of an examination of the technical officers of that Department of the description of the intended boundaries as contained in the draft bill, and that the following is an extract from that Report:—

> A comparison of the description in the draft bill with the English text of the Order in Council of the 8th July, 1896, has elicited the following remarks:
>
> 1. In the first and second lines of the description, the words "puis le long de la province d'Ontario", are a literal translation of the words in the description in the Order in Council, but unfortunately there is a mistake here in the Order in Council. Instead of "along the Province of Ontario due north to the shore",

it should have read "due north along the eastern boundary of the Province of Ontario to the shore". The error has been made in copying the report to Council.

2. In the fourth line instead of northeasterly "The French translation has "au nord".

3. At the bottom of the same page, the French reads "puis le long des lacs Birch, etc.," The English text reads "along the middle of Birch, &c."

4. In the second line on the next page channel "has been translated by "canal". This may be a mistake in copying Canal instead of "chenal", which is the correct translation of "channel" in this case.'

The Committee on the recommendation of the Minister of Justice, advise that a certified copy of this Minute, if approved, be forwarded to His Honour the Lieutenant Governor of Quebec, and that he be requested to call the special attention of his Government to the points to which reference is made in the report from the Department of the Interior.

RODOLPHE BOUDREAU,
Clerk of the Privy Council.

HOTEL DU GOUVEREMENT.
QUÉBEC, 25 octobre, 1897.

MONSIEUR,—Référant à votre dépêche du 3 mai dernier (1897) No. 4579.96, relativement à la délimitation des frontières Nord, Nord-est et Nord-Ouest de la province de Québec, j'ai l'honneur de vous transmettre, sous ce pli, un projet de la mesure que mon Gouvernement se propose de présenter à ce sujet à la prochaine session.

J'ai l'honneur, etc.,

(Signé) J. A. CHAPLEAU,
Lieutenant Gouverneur.

L'Honorable Secrétaire d'Etat,
Ottawa.

Loi concernant la délimitation des frontières Nord-Ouest Nord et Nord-Est de la province de Québec.

Attendu que la loi 34-35 Victoria, chapitre 28, du parlement du Royaume-Uni de la Grande-Bretagne et d'Irlande, intitulée "Acte concernant l'établissement des provinces dans la Puissance du Canada" decrète que "le parlement du Canada pourra, de temps à autre avec le consentement de la Législature d'une province, augmenter, diminuer ou autrement modifier les limites de cette province, aux termes et conditions acceptées par la dite legislature, et qu'il pourra de même, avec ce consentement, prescrire des dispositions concernant l'effet et l'opération de cette augmentation, diminution ou modification de territoire.

Attendu qu'il a été convenu entre le gouvernement du Canada et celui de cette province que les limites Nord-Ouest, Nord et Nord-Est de la province de Québec seraient celles qui sont ci-après indiquées, et qu'il convient de donner effet à cette convention.

En conséquence, Sa Majesté, par et de l'avis et du consentement de la legislature de Québec, décrète ce qui suit:—

(1) La législature de la province de Québec consent à ce que le parlement du Canada déclare que la ligne des frontières Nord-Ouest, Nord et Nord-Est de la province de Québec soit comme suit:—

Partant de la tête du lac Temiscamingue, puis le long de la province d'Ontario au Nord jusqu'à la rive de la partie de la Baie d'Hudson, connue généralement sous le nom de Baie James, de là au nord et en suivant la dite rive jusqu'à l'embouchure de

la rivière East Main, puis à l'est en montant le long du milieu de la dite rivière jusqu'au confluent du bras de cette rivière venant du lac Patamisk, de là en montant le long du dit dit bras jusqu'au lac Patamish, puis le long du milieu du dit lac jusqu'au point extrême nord, le dit point étant à environ quinze milles au sud du poste de la compagnie de la Baie d'Hudson sur le lac Nichigun et, à peu près à 52 degrés et cinquante cinq minutes de latitude nord, et à 70 degrés et quarante deux minutes de longitude ouest de Greenwich; de là à l'est le long de la parralèle de latitude du dit point jusqu'au point d'intersection de la rivière déchargeant les eaux du lac Ashuampi, connue sous les noms de rivières Hamilton, rivière Ashuampi ou de grande rivière des Esquimaux, puis en descendant le long du milieu de la dite rivière par les lacs Menihek, Marble, Astray et Dyke, jusqu'à la sortie la plus au sud du lac Dyke, de là le long du milieu de la dite sortie jusqu'au lac Birch, puis le long des lacs Birch et Sandgirt jusqu'au débouche extrême sud du lac Sandgirt, de la le long du milieu du canal sud de la rivière Hamilton jusqu'au las à la fleur (Flour), puis le long du milieu du lac à la fleur jusqu'à sa sortie, de là le long du milieu de la rivière Hamilton jusqu'à la Baie du Rigolet ou Anse Hamilton, puis à l'est le long du milieu de la dite baie ou Anse jusqu'au point de contact de la frontière ouest du territoire soumis à la juridiction de Terreneuve et de là au sud, le long de la dite frontière jusqu'au point de contact avec la rive nord de l'Anse au Sablon, dans le golfe St. Laurent.

(2) Cette loi entrera en vigueur le jour de sa sanction.

DEPARTMENT OF JUSTICE.

OTTAWA, 27th January, 1898.

To His Excellency

The Governor General in Council:

Upon the despatch from His Honour The Lieutenant Governor of Quebec of the 17th ultimo (616K.) relating to the proposed legislation concerning the Northwestern, Northern, and Northeastern boundaries of the Province of Quebec, the undersigned has the honour to report that for the present there does not seem to be any need for action on the part of Your Excellency's Government beyond the acknowledgment of the receipt of that despatch. When the proposed Act of the Legislature of Quebec has been passed a bill should be prepared for submission to Parliament fixing the boundaries of the Province in accordance with the understanding arrived at between the two Governments.

Respectfully submitted,

(Sd.) DAVID MILLS,
Minister of Justice.

HOTEL DU GOUVERNEMENT.

QUEBEC, 17 décembre, 1897.

MONSIEUR,—Référant à votre dépêche du 14 du courant, (Dossier No. 4679 96), j'ai l'honneur de vous transmettre, sous ce pli, copie du bill "concernant la délimitation des frontières Nord-Ouest, Nord et Nord-Est de la Province de Québec," soumis à l'Assemblée Législative le 29 Novembre, 1897, ainsi que copie d'une lettre de M. l'Assistant Commissaire des Terres au sujet de certaines erreurs de traduction dans la description des bornes.

J'ai l'honneur, etc.,

(signé) J. A. CHAPLEAU,
Lieutenant Gouverneur.

L'honorable Secrétaire d'Etat,
Ottawa.

QUÉBEC, 15 décembre, 1897.

L'Honorable J. E. ROBIDOUX,

Secrétaire Provincial,
Québec.

MONSIEUR LE MINISTRE.—J'accuse réception du dossier 2862-1896, de votre département, ayant trait à la question de la définition de la ligne frontière nord et nord-est de la province de Québec et des corrections qui sont signalées par les autorités fédérales comme devant être apportées à la traduction de la description de cette ligne ainsi que renfermée dans l'Arrêté du conseil privé d'Ottawa, en date du 8 juillet 1896.

En réponse, je suis chargé par l'honorable S. N. Parent, Commissaire des Terres, Forêts et Pêcheries, de vous informer que les changements requis, ont été faits et qu'ils apparaissent dans la version française du projet de loi soumis à l'Assemblée Législative de la Province de Québec, le 29 novembre dernier, ainsi que l'on peut le constater sur l'exemplaire de ce projet de loi que je vous transmets sous ce pli.

Cependant le mot *canal* dont l'on s'est servi comme traduction de *channel* dans ce projet, n'a pu être changé, vu que d'après les meilleures autorités, il répond mieux à l'idée de l'ensemble de l'eau et du lit de la rivière que l'expression anglaise semble ici devoir impliquer. Voir Bescherelle au mot canal et chenal. Fleming et Tibbits au mot channel. Quant aux erreurs que comporte l'original de la description annexée à l'Arrêté en conseil fédéral du 8 juillet 1896, elles seront corrigées de la manière indiquée dans l'Arrêté du 10 décembre présent, et ce, par un amendement qui sera proposé lors de la présentation du projet de loi du Conseil Législatif.

J'ai l'honneur d'être

Monsieur le Ministre,

Votre obéissant serviteur,

(Signé) E. E. TACHE
Assistant Commissaire.

Copie conforme
(Signé) JOS. BOIVIN,
Assistant Secrétaire de la province.

(SOUMIS À L'ASSEMBLÉE LEGISLATIVE—le 29 NOV., 1897).

(*Bill de L'Assemblée, No. 2*).

Loi concernant la délimitation des frontières nord-ouest, nord et nord-est de la province de Québec.

Attendu que la loi 34-35 Victoria, chapitre 28, du parlement du Royaume-Uni de la Grande-Bretagne et d'Irlande, intitulée: "Acte concernant l'établissement des provinces dans la Puissance du Canada" décrète que le parlement du Canada pourra, de temps à autre, avec le consentment de la législature d'une province, augmenter, diminuer ou autrement modifier les limites de cette province, aux termes et conditions acceptées par la dite législature, et qu'il pourra de même, avec ce consentement, prescrire des dispositions concernant l'effet et l'opération de cette augmentation, diminution ou modification de territoire.

Attendu qu'il a été convenu entre le gouvernement du Canada et celui de cette province que les limites nord-ouest, nord et nord-est de la province de Québec seraient celles qui sont ci-après indiquées, et qu'il convient de donner effet à cette convention.

En conséquence, Sa Majesté, par et de l'avis et du consentement de la législature de Québec, décrète ce qui suit.

SESSIONAL PAPER No 65

1. La législature de la province de Québec consent à ce que le parlement du Canada déclare que la ligne des frontières nord-ouest, nord et nord-est de la province de Québec soit comme suit.

Partant de la tête du lac Témiscamingue, puis suivant la limite est de la province d'Ontario, nord vrai, jusqu'à la rive de la partie de la baie d'Hudson, comme généralement sous le nom de baie James; de là dans une direction nord-est, et en suivant la dite rive jusqu'à l'embouchure du fleuve East-Main, puis vers l'est suivant le milieu du dit fleuve, en remontant, jusqu'à l'embouchure de son affluent venant du lac Patamisk; de là, le milieu de cet affluent, en remontant, jusqu'au lac Patamisk, puis le milieu du dit lac jusqu'au son point extrême nord, ce point étant situé à quinze milles environ au sud du poste de la compagnie de la baie d'Hudson, sur le lac Nichigun, et par cinquante-deux degrés et cinquante-cinq minutes de latitude nord, et soixante-dix degrés et quarante-deux minutes de longitude ouest de Greenwich approximativement; de là, vers l'est, suivent la parallèle de latitude du dit point jusqu'à la rencontre du fleuve dans lequel se déversent les eaux du lac Ashuanipi, et qui est connu sous les noms de fleuve Hamilton, Ashuanipi ou de grande rivière des Esquimaux, puis, en descendant et suivant le milieu du dit fleuve, par les lacs Menihek, Marble, Astray et Dyke, jusqu'à la décharge la plus au sud du lac Dyke, et de là en suivant le milieu de la dite décharge jusqu'au lac Birch, puis suivant le milieu des lacs Birch et Sandgirt jusqu'à la décharge extrême sud du lac Sandgirt; de là, suivant le milieu du canal sud du fleuve Hamilton jusqu'au lac à la Fleur (*Flour*), puis suivant le milieu du lac à la Fleur jusqu'à sa décharge; de là, suivant milieu du fleuve Hamilton jusqu'à la baie du Rigolet ou Hamilton Inlet, puis vers l'est suivant le milieu de la dite baie jusqu'à la rencontre de la frontière ouest du territoire soumis à la juridiction de Terreneuve, et, de là, vers le sud, en suivant la dite frontière jusqu'à la rive nord de l'Anse au Sablon, dans le golfe St-Laurent, la dite ligne étant désignée en rouge jusqu'à l'Anse Hamilton, sur la carte accompagnant la copie de l'Arrêté du gouverneur général en conseil No. 2623, en date du 8 juillet 1896, transmise au lieutenant-gouverneur de cette province et maintenant déposée dans les archives du secrétaire de la province.

2. Cette loi entrera en vigueur le jour de sa sanction.

DEPARTMENT OF JUSTICE.

OTTAWA, 8th, March, 1898.

To His Excellency

The Governor General in Council:

Upon the despatch from His Honour the Lieutnant Governor of the Province of Quebec of the 25th. ultimo, No. 735 K, transmitting copies in French and English of an Act passed at the recent session of the Legislature of that Province "respecting delimitation of the North-western, Northern and North-eastern boundaries of the Province of Quebec," the undersigned has the honour to report that the consent of the Legislature of the Province having now been given to a declaration by the Parliament of Canada establishing the new boundaries, there should, in his opinion, be legislation at the present session declaring that these shall hereafter be the North-western Northern and North-eastern boundaries of the Province.

The undersigned submits a draft bill having that object in view.

Respectfully submitted,

(sd.) DAVID MILLS,
Minister of Justice.

MAP OF PART OF **LABRADOR** ILLUSTRATING THE PROPOSED **NORTHERN BOUNDARY** OF THE **PROVINCE OF QUEBEC**

To accompany the report of the Deputy Minister of the Interior, dated the 29th January, 1896

RETURN

(67)

To an Order of the House of Commons, dated the 5th December, 1910, calling for a copy of all correspondence, reports, memorials, surveys and other papers in the possession of the government, and not already brought down regarding the oyster industry of Canada; also a copy of all correspondence, reports and other papers regarding the ownership and control of oyster beds and of barren bottoms suitable for oyster culture, and regarding the consolidating of the ownership with the control and regulation of such beds and barren bottoms, and vesting the same in the hands of the Dominion government; also a copy of all correspondence, reports, recommendations and other papers relating to the leasing or sale of such beds or barren bottoms, or of portions of them, for the purpose of oyster culture or cultivation. Also a copy of all correspondence and reports relating to the culture, cultivation and conservation of oysters and other mollusks.

CHAS. MURPHY,
Secretary of State.

16th December, 1910.

CHARLOTTETOWN, P.E.I.,
15th March, 1910.

SIR,—I am in receipt of your letter of the 10th inst., referring to moving of small oysters from the bars, and placing them on the deep water beds in Richmond Bay.

I am strongly of the opinion that this work is far more valuable than anyone is aware of, as the oysters are scattered over a large area of natural ground, and the growth of these oysters thus transplanted is rapid. There are also a large number of these oysters which will throw off their spat during the spatting season, and the fishermen appreciate the step the department have taken in this matter.

As requested I will arrange to have this work carried out during the coming season.

I am, sir,
Your obedient servant,
ERNEST KEMP,
Oyster Expert.

March 10, 1910.

R. N. VENNING, ESQ.,
Superintendent of Fisheries,
Ottawa.

SIR,—Adverting to previous correspondence, in regard to the removing of small oysters from the bars in Malpeque Bay, Prince Edward Island, and placing them on the natural oyster beds, I may say that as the work performed in this direction last

fall was successful, and resulted in the placing on the natural beds of 569 bushels of small oysters that would otherwise have perished, it seems very desirable that the same course should be followed next year, and you will therefore arrange at the most suitable time next season for the collection of these small oysters, as far as possible, by the crew of the *Ostrea*, thus keeping the expense of the work down to a minimum, and have these placed on the natural oyster beds under your direct supervision.

I am, sir,

Your obedient servant,

(Sgd.) W. A. FOUND.

For Superintendent of Fisheries.

March 10, 1910.

E. KEMP, ESQ.,
Oyster Expert,
Charlottetown, P.E.I.

DEAR MR. RICHARDS,—I beg to acknowledge your letter of the 7th instant, referring to the successful stocking of natural oyster beds in Malpeque Bay last year, by the gathering of small oysters that had been thrown up on the bars about the Bay, and which would otherwise have perished, and requesting that the same course be followed next year.

In reply I may say that last year 569 bushels of small oysters were gathered from these bars under the supervision of Captain Kemp, the oyster expert, and were placed on the natural beds, and as it is felt that the results of such work must be most satisfactory in the public interest, I am pleased to inform you that the oyster expert will be directed to follow the same course next year.

Yours faithfully

(Sgd.) C. STANTON,
Assistant Deputy Minister.

Honourable JAMES W. RICHARDS, M.P.,
House of Commons.

HOUSE OF COMMONS,
OTTAWA, March 7, 1910.

GEO. J. DESBARATS, ESQ.,
Deputy Minister of Marine and Fisheries,
Ottawa, Ont.

DEAR SIR,—During the summer of 1909, Captain Kemp, with the assistance of a man or two, took up some small oysters which were found on the shoals and around the islands in Richmond Bay, P.E.I. These small oysters were planted upon the old beds. This step, ordered by the Fisheries Department, is likely to be productive of a very great deal of good in the way of re-stocking the oyster beds.

My object in writing is to make a request that this work of replanting oysters shall be continued during the coming season. I know that Mr. Venning is conversant with the whole matter, and I feel confident that he will recommend that the work of replanting be continued in Richmond Bay.

I shall be much obliged if you will kindly look into this matter, and be good enough to let me have a reply.

Yours very truly,

(Sgd.) JAMES W. RICHARDS.

C.G.S. "OSTREA,"
SHEDIAC, N.B.,
19th October, 1909.

SIR,—I beg to enclose statement of oysters obtained in Richmond Bay from the bars and points of the Islands, and deposited on the natural beds in the above bay.

The statement shows the number of oysters received each day, with the names of the persons engaged, and the amount paid for same.

The balance of the $500 advance received for that purpose and not used, I have placed to the credit of Receiver General amounting to $101.70 and enclose Bank's receipt.

I am, sir,
Your obedient servant,
(Sgd.) ERNEST KEMP,
Oyster Expert.

R. N. VENNING, ESQ.,
Superintendent of Fisheries,
Ottawa.

COPY.

Small oysters picked from bars in Richmond Bay, Sept.,

Name.	Thursday, Sept. 23.		Saturday, Sept. 26.		Tuesday, Sept. 28.	
	Oysters, ½ bush	Amount paid.	Oysters, ½ bush.	Amount, paid.	Oysters, ½ bush.	Amount paid.
		$ cts.		$ cts.		$ cts.
Abram Thomas	10	3 50	5	1 75	6	2 10
Peter Labole	8	2 80				
John Labole	7	2 45				
Geo. Brown	6	2 10	10	3 50		
J. Ferguson	18	6 30				
Lem Labole			8	2 80	10	3 50
Antony Labole			7	2 45	4	1 40
John Copage			5	1 75	5	1 75
E. Linklater			3	1 05		
Chas. Mills			9	3 15		
Wm. Peters					6	2 10
Abram Bernard					7	2 45
Mathew Mitchell					5	1 75
Patrick Sark					4	1 40
Michael Sark					3	1 05
Peter Knockwood					4	1 40
Patrick Bernard						
Sylvan Sark						
Joe Abram						
	49	17 15	47	16 45	54	18 90

I hereby certify the above goods have been received and planted and the price paid is fair and just.

(Sgd) Ernest Kemp, Oyster Expert.

STATEMENT: 17th Sept. 890 baskets at 35c.....$ 311 50
8th Oct. 248 " at 35c..... 86 80

1138 " $ 398 30

1909, at 35c. per bushel or at the rate of $1.75 per barrel.

Wednesday, Sept. 29.		Thursday, Sept. 30.		Friday, Oct. 1, 1909.		Tuesday, Oct. 5.		Total.	
Oysters. ½ bush.	Amount. paid.	Oysters. ½ bush.	Amount. paid.	Oysters. ½ bush.	Amount. paid.	Oysters ½ bush.	Amount paid.	Oysters	
	$ cts.		$ cts.		$ cts.		$ cts.		$ cts.
4	1 40	2	0 70			2	0 70	29	10 15
								8	2 80
		2	0 70					9	3 15
		3	1 05					19	6 65
								18	6 30
4	1 40	8	2 80	3	1 05	1	0 35	34	11 90
5	1 75	5	1 75					21	7 35
2	0 70							12	4 20
								3	1 05
						2	0 70	11	3 85
4	1 40	8	2 80					18	6 30
5	1 75	4	1 40			4	1 40	20	7 00
								5	1 75
		2	0 70					6	2 10
2	0 70					5	1 75	10	3 50
								4	1 40
4	1 40							4	1 40
6	2 10	2	0 70					8	2 80
		2	0 70			7	2 45	9	3 15
36	12 60	38	13 30	3	1 05	21	7 35	248	86 80

I also certify to the above being correct.

(Sgd) D. W. Forbes.

ADVANCE: $500.00

Paid for oysters, as per statement	$ 398 30
Returned through Receiver General	101 70
	$ 500 00

Correct,
(Sgd) E. Kemp.

COPY.

Small oysters picked from bars in Richmond Bay, Sept.,

Name.	Friday, 10th Sept.		Monday, 13th Sept.	
	Oysters, ½ bush.	Amount paid.	Oysters, ½ bush.	Amount paid.
		$ cts.		$ cts.
Michael Sark	45	15 75	29	10 15
Patrick Sark	7	2 45	11	3 85
John Labole	20	7 00	14	4 90
Peter Labole	20	7 00	10	3 50
Antony Labole	17	5 95	12	4 20
Dennis Louis	4	1 40	11	3 85
Charlie Louis	8	2 80	10	3 50
Mathew Mitchell	39	13 65	21	7 35
Lewis Miller	12	4 20	13	4 55
Peter Knockwood	6	2 10	7	2 45
Joe Abram	8	2 80	22	7 70
J. Ferguson	30	10 50	25	8 75
Simon Francis			24	8 40
Tom Snake			16	5 60
E. Linklater			12	4 20
Geo. Brown			10	3 50
Chas. Mills			5	1 75
Dan. Francis			6	2 10
Frank Thomas			13	6 30
Peters, Wm				
Lem Labole				
Abram Thomas				
Wm. Arseneau				
Jacob Sark				
Dan Peters				
Sylvan Sark				
John W. Peters				
	216	75 60	276	96 60

I hereby certify the above goods have been received and planted and the price paid is fair and just.

(Sgd) Ernest Kempt, Expert, 18th., 1909.

1909, at 35c. per ½ barrel or at the rate of $1.75 per barrel.

Wednesday, 15th Sept.		Thursday, 16th Sept.		Friday, 17th Sept.		Total.	
Oysters, ½ bush.	Amount paid.	Oysters, ½ bush.	Amount paid.	Oysters, ½ bush.	Amount paid.	Oysters, ½ bush.	Amount paid.
	$ cts.		$ cts.		$ cts.		$ cts.
29	10 15					103	36 05
17	5 95	2	0 70	1	0 35	38	13 30
3	1 05	1	0 35			38	13 30
5	1 75	10	3 50			45	15 75
5	1 75					34	11 90
6	2 10	7	2 45			28	9 80
7	2 45	8	2 80			33	11 55
16	5 60	26	9 10	2	0 70	104	36 40
13	4 55	7	2 45			45	15 75
10	3 50	5	1 75			28	9 80
						30	10 50
16	5 60	15	5 25	8	2 80	94	32 90
23	8 05	12	4 20	5	1 75	64	22 40
4	1 40	5	1 75	1	0 35	26	9 10
		6	2 10			18	6 30
6	2 10	4	1 40			20	7 00
						5	1 75
9	3 15	3	1 05			18	6 30
16	5 60	10	3 50	2	0 70	46	16 10
14	4 90					14	4 90
7	2 45	8	2 80	2	0 70	17	5 95
9	3 15	4	1 40	2	0 70	15	5 25
		7	2 45			7	2 45
		5	1 75	3	1 05	8	2 80
		2	0 70			2	0 70
		5	1 75			5	1 75
				5	1 75	5	1 75
215	75 25	152	53 20	31	10 85	890	311 50

I also certify to the above being correct.

(Sgd.) D. W. Forbes.

1-2 GEORGE V., A. 1911

C.G.S. 'OSTREA,'
MALPEQUE, P.E.I.,
4th October, 1909.

SIR,—Since my last letter I have received the following oysters,—Thursday, 23rd September, 24½ bushels, none were obtained before as the tides and weather would not permit. On Saturday the 25th, 24 bushels, on Tuesday, 28th, 27 bushels, Wednesday, 29th, 18 bushels, Thursday, 30th, 19 bushels, and on Friday, 1½ bushels. Since then it has been blowing a heavy north-east gale and thick with rain, but now the oyster season is open I do not think I can get many more, as the bars have been picked nearly clean.

I will send a full statement on when I have closed my work here.

I am, sir,

Your obedient servant,

(Sgd.) ERNEST KEMP,
Oyster Expert.

R. N. VENNING, ESQ.,
Superintendent of Fisheries,
Ottawa.

C.G.S. 'OSTREA,'
MALPEQUE, P.E.I.,
18th September, 1909.

SIR,—I beg to inform you that on the 10th inst. 108 bushels of small oysters were received on board the *Ostrea*, these were planted on the following day, but no picking was done on Saturday as the tides did not go off far enough.

On Monday 138 bushels were received and planted the following day, no picking being done on account of stormy winds and high tide. On Wednesday 107½ bushels were received and planted on Thursday. The 16th, 76 bushels were received and planted the following day, and on Friday 15½ bushels were received and planted to-day, no picking being done as there is a strong northerly wind blowing which keeps the tide up. There are upwards of 27 men with their families picking and they are all clamouring for cash.

With reference to the crew of the *Ostrea* picking these small oysters, their time is fully occupied on board the boat, in receiving and trimming the oysters as they come on board, and planting same and keeping boat in order. Mr. Dan. Forbes and John Ferguson have also been on board the boat, and assisted in placing the oysters on the most suitable localities which are thinly spread over the largest of the deep water beds.

I am, sir,

Your obedient servant,

(Sgd.) ERNEST KEMP,
Oyster Expert

R. N. VENNING, ESQ.,
Superintendent of Fisheries,
Ottawa.

C.G.S. 'Ostrea,'
Malpeque, P.E.I.,
13th September, 1909.

Superintendent of Fisheries,
Ottawa.

Sir,—I am in receipt of your telegram of the 8th inst. which reads as follows:—'E Kemp, Str. *Ostrea,* Malpeque. You are authorized to remove small oysters from bars Malpeque Bay, utilizing *Ostrea's* crew as much as possible. (Sgd). R. N. Venning, Ottawa.'

I then made arrangements to pick up the small oysters on the north point of Ram Island. Last Saturday about 43 barrels were laid and to-day upwards of 55 barrels oysters were received. Have just sent the following telegram:—'R. N. Venning, Esq., M. & F. Dept., Ottawa. Please advance five hundred dollars immediately to pay pickers who expect cash on delivery. One hundred barrels already received at one-seventy-five, am writing particulars. See Doutre. (Sgd.) E. Kemp, C.G.S. *Ostrea.*'

The men who catch oysters and quahaugs are always paid for their daily catch on delivery, and the men employed are asking for the same terms, and I have not sufficient cash on hand to do so, hence my telegram. I saw Mr. Doutre this morning and explained the matter to him.

The quahaug fishermen in Malpeque Bay are now earning on an average from $7 to $10 per day.

I think probably to-day's catch will be the heaviest as the men will soon thin them out.

How many oysters do you wish me to receive, to transplant in Richmond Bay? The sample is a splendid one, and I hope good results will follow as they will be spread thinly over a large area.

I am, sir,
Your obedient servant,
(Sgd.) ERNEST KEMP.
Oyster Expert.

R. N. Venning, Esq.,
Superintendent of Fisheries,
Ottawa.

THE GREAT NORTH WESTERN TELEGRAPH COMPANY OF CANADA.

29 Collect. Via Eds., 33 & 76.
Malpeque, P.E.I.,
13th September, 1909.

R. N. Venning,
M. & F., Ottawa.

Please advance five hundred dollars immediately to pay pickers who expect cash on delivery. One hundred barrels already received at one seventy five, am writing particulars. *See* Doutre.

(Sgd.) ERNEST KEMP.

September 8th, 1909.

SIR,—Adverting to your report of the 31st ultimo, and to your wire of the 6th instant, I telegraphed you yesterday as follows:—

'You are authorized to remove small oysters from bars, Malpeque bay, utilizing *Ostrea's* crew as much as possible,'

which I now confirm.

The department feels that the crew of the *Ostera* should be able to render a great deal of assistance in collecting the small oysters on the bars about the bay, as there would not appear to be any work for them to do on the boat during such time as you are engaged in supervising the removal of these small oysters, and as you are aware it is the department's desire that no unnecessary expenses should be incurred.

It is felt that the effect of placing these small oysters on the public beds should be very beneficial, as they should have passed beyond the stage when there would be much danger in transplanting them.

I should be obliged for a report from you from time to time as to how the work is proceeding, the quantities of small oysters that are being transplanted and the cost involved.

You will remember that it is the department's desire that you should later on, if possible, visit Chedabucto Bay, and in any event it is necessary that you should go to Annapolis Basin and fully report in regard to the conditions existing in connection with the bed that was planted by you some years ago; but it would not seem necessary for you to take the *Ostrea* around in visiting this locality.

I am, sir,

Your obedient servant,

(Sgd.) R. N. VENNING,

Superintendent of Fisheries.

ERNEST KEMP,
Steamer *Ostrea*,
Malpeque, P.E.I.

OTTAWA, September 7th, 1909.

E. KEMP,
Steamer *Ostrea*,
Malpeque, P.E.I.

You are authorized to remove small oysters from bars Malpeque Bay, utilizing *Ostrea's* crew as much as possible.

(Sgd.) R. N. VENNING.

Chge. M. & F.

THE GREAT NORTH-WESTERN TELEGRAPH COMPANY OF CANADA.

86 Be Rn 18 Coll 1.25 P.m Via Eds,

MALPEQUE, P.E.I., Sept. 6th.

R. N. VENNING,
M. & F. Dept. Ottawa, Ont.

Dr. Stafford has finished with *Ostreas* service. Wire instructions *re* my letter of thirty-first of August.

(Sgd.) ERNEST KEMP,

C.G.S. 'Ostrea.'

Malpeque, P.E.I.,

31st August, 1909.

Sir,—I am in receipt of your letter of the 19th inst., referring to the removal of small oysters which are deposited on the reefs in Malpeque Bay.

The *Ostrea* would serve the purpose of receiving the small oysters collected, and depositing the same on the beds, but I was under the impression the work would be slow, and that her services might be utilized in another way.

The best months to obtain these small oysters would be June and July as no shell fishing is done at that time and the water is warm, but now the quahaug fishing commences on the 1st of September and oyster fishing follows on the 1st October, so that men are scarce, but I think Indians might be employed at a reasonable figure during the following month.

If any action is taken in this matter, it should be done at once, as the water will soon be too cold to wade in, and the days are getting shorter, but I feel sure it would be a move in the right direction, and give satisfaction to all the fishermen who fish in these waters.

I had an interview with Mr. Dan Forbes, Fishery Officer of Tyne Valley and he stated that he would only be too willing to render any assistance, as he feels everyone in the industry would be benefited by the removal of small oysters from the bars and reefs and placed on natural beds.

The *Ostrea* is now at Malpeque with Dr. Stafford, who will finish his work in a few days, and if the department will wire me their decision on receipt of this letter, I will remain and do my best.

It would be impossible to do any work here, after the *Ostrea* is laid up as suggested in your letter, as the season would be too far advanced.

I am, sir,

Your obedient servant,

(Sgd.) ERNEST KEMP,

Oyster Expert.

R. N. Venning, Esq.,
Superintendent of Fisheries,
Ottawa.

August 19th, 1909.

Dear Mr. Richards,—

I have to acknowledge the receipt of your letter of the 12th instant, in which you refer to the fact that it is frequently the case that small oysters are deposited on reefs around a small island in Malpeque bay, which are killed by the ice and frost during the winter season, and suggesting that arrangements might be made to have these little oysters picked up and deposited on the public beds.

In reply I may say that the department has had this matter under consideration, and it feels that the work could be most successfully carried on under the supervision of the oyster expert.

While it may not be practicable to have the steamboat *Ostrea* detailed for this service, it would seem that the work would require to be done in the fall after she is laid up, and the department is, therefore, at the moment in correspondence with Mr. Kemp, the oyster expert, with a view to reaching a decision as to the most practicable steps to take in the matter.

Yours faithfully,

G. J. DESBARATS.

August 19, 1909.

SIR,—Adverting to my letter of the 14th May, 1908, in regard to the removal of small oysters which are deposited on reefs in Malpeque bay, and to which you replied on the 27th of that month, I may say that the matter is again before the department.

Though from your reply it would not seem practicable to detail the *Ostera* for this service. It would seem to the department that the work should be carried on under your supervision, and that at times when these small oysters are thrown up in numbers the depositing of them on the public beds under such conditions as would insure their growth, would seem to result in great benefit to the future of the industry.

It would not seem practicable to employ children indiscriminately in the picking of these oysters, as it would be impossible for any adequate supervision to be kept over the matter, and as the time when the removal of these oysters could best be carried on would seem to be in the fall just after the *Ostrea* would be laid up, it would appear that you might readily visit the localities where these reefs exist and make the necessary arrangements for the gathering of these small oysters and supervise the depositing thereof on the public beds.

I should be obliged for your full views on this matter with the least possible delay.

I am, sir,

Your obedient servant,

R. N. VENNING,

Superintendent of Fisheries.

ERNEST KEMP, Esq.,
Oyster Expert,
Charlottetown, P.E.I.

CHARLOTTETOWN, P.E.I.
August 12, 1909.

G. J. DESBARATS, ESQ.,
Deputy Minister of Marine and Fisheries,
Ottawa,

DEAR SIR,—In the absence of Hon. Mr. Brodeur, I am now writing you in reference to a matter concerning the oyster beds in Richmond or Malpeque bay, Prince County, P.E.I.

There is a considerable quantity of small oysters on the reefs of a small island in that bay. These small oysters are liable to be destroyed when the ice forms. Men, who seem to know a good deal about the oyster fishing business have suggested to me that the small oysters on these reefs of the little island mentioned could be picked up and placed in the public beds in the bay. In this way those small oysters can be turned to good account, as they would help to replenish the public beds. I think this suggestion is a good one. The fishery guardians in that neighbourhood could get these small oysters picked up for about $1 to $1.50 per barrel and have them placed upon the public beds. The total cost of doing this work would probably amount to about $100, and I am strongly of the opinion that it would be money well expended and would be a step in the interest of preserving the oyster business. The fisherman, who take oysters from the public beds, are most anxious that what I have suggested should be done.

I think that some time ago your Inspector of Fisheries here, Mr. John A. Matheson, recommended what I am now suggesting. I will be very glad if you will have this matter looked into, and if you will communicate with Mr. Matheson I feel sure that he will be able to confirm what I have expressed. It is manifest that something in

this line should be done in order to foster the oyster fishing on the public beds in Malpeque Bay.

I will be obliged if you will kindly have this matter looked into and let me hear from you at your earliest convenience.

Yours truly,

(Sgd.) JAMES W. RICHARDS, M.P..

October 20, 1910.

Dear Mr. Haszard,—On receipt of your letter of the 12th inst. urging that the question of a *modus vivendi* in connection with the oyster industry should be finally disposed of at an early date, I wired the Attorney General for Nova Scotia for the decision of his government in the matter, as the Premier of New Brunsiwck had a short time ago expressed himself as willing to enter into a suitable arrangement, and I am pleased to inform you that I am now in receipt of a reply from the Attorney General for Nova Scotia, in which he states that his government will be prepared to enter into a *modus vivendi,* if your government and that of New Brunswick is.

I am particularly pleased that the governments of the three maritime provinces have taken this view of the matter, as I am convinced, as pointed out in previous correspondence, that the only method by which the oyster fishery can be satisfactorily expanded and an important industry built up, inuring to the permanent advantage of the different provinces concerned, is by private culture on areas leased to individuals.

I am now causing the Department of Justice to be requested to prepare a formal *modus vivendi* with the three maritime provinces, embracing terms as outlined in previous correspondence, which I am confident will be entirely acceptable, as my object is to have an arrangement reached which will make it perfectly clear that the question of fishery rights will not be affected in any sense, either to the advantage or disadvantage of any of the governments concerned; but which will enable these to whom leases are granted to feel assured that they will be maintained by both governments, if necessary, in their holdings.

I trust that the formal *modus vivendi* will be ready at an early date, and I shall not lose time in having it communicated to the different governments connected.

Yours faithfully,

L. P. BRODEUR.

Honourable F. L. Haszard,
Premier Prince Edward Island,
Charlottetown, P.E.I.

October 20, 1910.

Dear Mr. Maclean,—I am much obliged for your telegram of the 18th instant, intimating that your government will be willing to enter into a *modus vivendi* in connection with the leasing of areas on which to carry on oyster culture, if the governments of New Brunswick and Prince Edward Island are agreed to do so.

Some time ago the Premier of Prince Edward Island expressed his willingness to enter into a suitable arrangement, even if the other provinces did not do so, as he appreciated that the only means by which the oyster industry can be built up and expanded is by private oyster culture on areas that have not previously been oyster producing, or on such as have become entirely depleted; but it was considered desirable that a *modus vivendi* should be reached with the three governments mainly interested, in order that the department might be in a position to do all in its power to encourage and stimulate the cultivation of oysters.

With this end in view the question was taken up with the Premier of New Brunswick, as well as with yourself, and on the 13th ultimo the Premier of New Brunswick intimated that his province was willing for this department to continue to conduct the oyster fishery as it did in the past—presumably previous to the decision of the Privy Council in 1898—pending a final settlement of the whole question of fishery rights, and as the Premier of Prince Edward Island was pressing for definite action in the matter I wired you, as I could not see any reason why the province should object to entering into a modus vivendi.

The object, as previously explained, is in no sense to inure to the advantage or disadvantage of either the federal or provincial governments, so far as the question of fishery rights is concerned; but to prevent continuing of marking time on account of a settlement not being finally reached. I am immediately causing the Department of Justice to be communicated with to prepare a formal *modus vivendi*, which will embrace terms which I am quite sure will make it entirely satisfactory to all parties concerned.

Yours faithfully,

L. P. BRODEUR.

Honourable A. K. MACLEAN,
Attorney General, Nova Scotia,
Halifax, N.S.

October 20, 1910.

SIR,—Previous to the decision of the Imperial Privy Council in the Fisheries Reference in 1898 this department, with a view to enabling expansion in the quantities of oysters produced, arranged for the licensing of areas to private individuals and firms, on which to carry on artificial and natural oyster culture, and in fact eighteen such licenses had been issued for areas in Prince Edward Island, six in Nova Scotia and seven in New Brunswick; but following the decision in question, owing to the unsettled state in which it left the question of fishery rights, as between the federal and provincial governments, all these leases were discontinued, with the exception of one in Prince Edward Island and two in New Brunswick, which have been renewed from year to year, pending a final settlement of the question, and in order to avoid conflict, the department has refrained from issuing licenses for additional areas.

Notwithstanding that the regulations procured and enforced by this department for the protection of the natural oyster beds, have been very restrictive, the oyster fishery keeps on declining and experience in this and other countries shows beyond doubt that the only method by which the oyster production can be largely and permanently increased, is by private oyster culture on leased areas, over which absolute control, so far as oyster fishing is concerned, can be exercised by the lessee.

As the natural conditions around large portions of the coasts of the maritime provinces are most favourable for oyster culture, it is regretable that the building up of new oyster producing areas has had to be held in check during the past twelve years, and with a view to reaching an arrangement whereby the department would be free to act in the matter, correspondence has been carried on with the governments of the three maritime provinces, which now express themselves quite ready to enter into a satisfactory *modus vivendi*, so far as the conduct of the oyster fishery is concerned, which would enable this department to issue such leases of areas as may be deemed desirable. From the correspondence a *modus vivendi*, embracing terms to the following effect, would seem acceptable to the provinces, and the minister has expressed himself as agreeable thereto,—

1. The granting by the Minister of Marine and Fisheries of leases of areas on which to carry on oyster culture, shall in no way, either directly or indirectly inure to

the advantage of the federal government, so far as the question of fishery rights is concerned;

2. Each lease shall contain a clause to the effect that it is issued with the concurrence of the provincial government affected, and that the lessee shall be sustained in his holdings by both governments, and in the event of necessity arising for the cancellation of the lease, by reason of nonfulfilment of the obligations by the lessee, or otherwise, or if any change in the terms of the lease is found essential, the federal government will not act without the consent of the provincial government affected;

3. The term of the leases granted shall be twenty years, and the fee charged shall be at the rate of one dollar per acre for the first ten years, and two dollars per acre thereafter;

4. Areas shall not exceed in extent five acres, and only barren bottoms, or defunct or entirely depleted oyster beds, shall be available for leasing;

5. All rentals shall be collected by the Department of Marine and Fisheries and paid in to the credit of the Receiver General for Canada; but half the amount collected in any province, after deducting the cost of protection of the oyster fisheries therein, shall be paid over to the government thereof, such payments, if any are due, shall be made during the month of April in each year;

6. Where necessity may arise therefor, areas shall be defined and set apart, in which the farmers may dig what is generally known as 'mussel mud';

7. As an object lesson to those contemplating artificial and natural oyster culture, the Department of Marine and Fisheries shall, within three years from the date hereof, establish an oyster bed in each province on an area that has never produced oysters in the past.

The minister directs me to request you to be good enough to draft a suitable form of *modus vivendi*, with the governments interested,—Prince Edward Island, Nova Scotia and New Brunswick,—embracing the effect of the above terms, if you see no substantial objection thereto, and to insert such other conditions as you may deem desirable.

You will appreciate that the object is to gain no advantage for any particular government, so far as the question of relative fishery rights is concerned: but to enable the building of a large and flourishing oyster industry in the only way that it is possible to do it.

As the season is now much advanced, those who are desirous to go into the venture should be in a position to do so at the earliest possible date, and the minister would therefore deem it an especial favour if you would be good enough to expedite the preparation of the form of *modus vivendi*, as much as you possibly can.

I am, sir, your obedient servant,

C. STANTON,

Assistant Deputy Minister of Marine and Fisheries.

The Deputy Minister,
Department of Justice.

HALIFAX, N.S., October 18, 1910.

Hon. L. P. BRODEUR,
Minister of Marine and Fisheries,
Ottawa.

Replying your wire of to-day. This province will agree to modus vivendi if Prince Edward Island and New Brunswick agree.

A. K. MACLEAN.

1-2 GEORGE V., A. 1911

Ottawa, October 18, 1910.

Honourable A. K. Maclean,
Attorney General.
Halifax, N.S.

Re letter August 5, oyster fishery *modus vivendi*, both Prince Edward Island and New Brunswick agreeable, and Island is pressing immediate action. As season advancing and no apparent objection to arrangement, which will be in best interests of industry and all concerned, please favour me with immediate reply.

L. P. BRODEUR.

Premier's Office, Charlottetown,
October 12, 1910.

Hon. L. P. Brodeur,
Minister of Marine and Fisheries,
Ottawa, Ont.

Dear Sir,—Some weeks ago I had some correspondence with your department regarding the *modus vivendi* in the matter of our fisheries, and I now write and ask whether it is possible to bring about any arrangement at once. The season is getting along, and before winter sets in we certainly ought to be in a position to deal with some oyster areas where some new beds could be laid down.

I would be glad if some move could be made in the matter at once if possible.

Yours faithfully,

F. L. HASZARD,
Premier.

Honourable J. D. Hazen, K.C.,
Premier and Attorney General,
Fredericton, N.B.

September 19, 1910.

Dear Sir,—I beg to thank you for your letter of the 13th instant, in which you state that after having communicated with Dr. Landry you are agreeable that this department should, pending a final decision of the question of fishery rights, deal with the granting of oyster fishery leases as has been done in the past.

I take it that you refer to previous to the decision of the Imperial Privy Council of 1898, as since that time this department has refrained from issuing any new licenses for oyster culture purposes, merely continuing the two in New Brunswick which were at that time in effect, and those have been renewed from year to year.

It is with a view to extending the culture of oysters that the department is now so anxious that something should be done.

I observe you suggest that 'barren bottoms' alone should be leased and not 'unproductive beds.'

There is a great deal of force in this view, but there is also strong reason for the opposite one.

You will readily appreciate that those first going into oyster culture will have a lot to learn, which can only be acquired by experience, and in order that they may not become discouraged it is eminently desirable that they should be working under the best possible advantages, and while there may be some causes why in a particular area on which oysters have never grown they will not be so satisfactorily, there can be no doubt about an area which in years past has borne oysters.

In the course of a short time when some good beds will have been built up, the question of the extension on to areas which have never been produced will be a very simple matter.

Of course the department would not consider for a moment the granting of leases for areas on which oysters are now growing; but beds which are entirely depleted and which have been given up by the public I am sure you will agree stand in a different light.

I am hopeful that a form of *modus vivendi* which will be entirely satisfactory to the three provinces will be ready in the course of a short time for submission and as soon as completed an arrangement will be made for its submission to the three maritime province governments for approval.

Yours faithfully,

A. JOHNSON.

St. John, N.B., September 13, 1910.

Deputy Minister of Marine and Fisheries,
Ottawa.

Re No. 3381.

Sir,—In reply to yours of the 7th inst., I beg to say that I have communicated with Dr. Landry, who was the representative of the New Brunswick government at the conference at Ottawa, and now desire to state that, pending the final decision of the question of fishery rights, my government is satisfied to have your department deal with this matter as you have done in the past.

If I may be permitted to make a recommendation with regard to the proposed work it would be that the 'barren bottom' be experimented upon by your department before the 'unproductive beds' are cultivated.

Yours truly,

J. D. HAZEN.

September 7, 1910.

Honourable A. K. Maclean,
Attorney General,
Halifax, N.S.

Sir,—I have your letter of the 30th, ultimo, in which you explain that as Mr. Barnstead is at present absent in England, it is difficult for you to go fully into the question of a *modus vivendi* in connection with the oyster fishery; but intimating that if one has been entered into with Prince Edward Island you would like to be informed of the full particulars thereof, to aid you in considering the matter.

As Prince Edward Island is possibly more vitally affected than any of the other provinces, and as nothing has been heard from the representatives of the different provincial governments following their visit to Ottawa last year, the matter was taken up with Honourable Mr. Haszard with a view to entering into an arrangement with Prince Edward Island even if such could not be achieved with the other provinces on the basis of the terms for a *modus vivendi*, a copy of which was inclosed in my previous letter of the 5th, ultimo.

Honourable Mr. Haszard states that if a contract is made by which it would be agreed that leases should be given, the granting of which should not inure to the advantage or disadvantage of either government so far as a claim to proprietary rights is concerned, there would, in his opinion, be no objection to the federal government granting such leases, and he further adds that he is agreed that a period of twenty years should be the term for the leases, and that he would consider a fee of one dollar

an acre for the first five years and thereafter two dollars an acre, a reasonable one, with a condition for cancellation if planting operations were not undertaken within the first three years, or in lieu of such fee, a royalty on each barrel of, say fifty cents; that the lessee should be assured of the joint covenants of both governments securing him in his holdings, and that no change should be made without the consent of both contracting parties.

It has been pointed out to Mr. Haszard that one dollar an acre is the current rate in most parts of the United States, and that even where a very large fishery has been built up a larger fee has been found to bear heavily on those engaging in the industry in many instances, and as no doubt both governments are mainly anxious for the building of a flourishing industry, rather than the obtaining of a revenue, and as in initial operations many unlooked for difficulties will no doubt be experienced, the department feels that no increase over one dollar an acre should be made in the fee for at least ten years.

There is, therefore, nothing to prevent an immediate arrangement with Prince Edward Island; but as there is chance for great development of the oyster industry in the three maritime provinces, it would seem too bad for the unsettled question of fishery rights to be longer allowed to hamper the chances of building up such industry; and I therefore hope that you will at a very early date find it possible to give the matter the fullest consideration, as I am sure you will see no reason why a *modus vivendi* between the two governments should not be entered into, especially as there is no intention of such arrangement in any way affecting the legal position of either the Dominion or the province so far as the proprietary interests of the fishery are concerned.

If an arrangement were consummated during the coming fall the department would be in a position to grant leases to such as may be prepared to go into the industry, in time to enable them to build up beds during the coming year.

I am, sir, your obedient servant,

C. STANTON,

Asst. Deputy Minister of Marine and Fisheries.

September 7, 1910.

Honourable J. D. Hazen, K.C.,
Premier and Attorney General,
Fredericton, N.B.

Sir,—I beg to revert to your letter of the 11th ultimo, in which you explained that you had forwarded my previous communication in regard to reaching a *modus vivendi* in connection with the leasing of areas for private oyster culture, to Dr. Landry, who was the representative of your government at the conference at Ottawa, and that after you had had an opportunity of conferring with him you would communicate with me further on the subject.

I have been hoping since that time to have a further letter from you; but as such has not been received I beg to again call your attention to the matter.

As the contemplated *modus vivendi* would not in any way affect the position of either government with regard to the question of fishery rights, it seems too bad that the unsettled state of that question should be allowed to continue to prevent the growth of an industry, which owing to the natural conditions existing, should be capable of being rapidly developed into one of great importance, and while, as previously explained, the Premier of Prince Edward Island has expressed his readiness to enter an arrangement and as it is not anticipated that there will be difficulty with Nova Scotia, you will appreciate that it would be eminently desirable in the general interest that the

same conditions should exist in the three maritime provinces, so that those prepared to go into the venture of oyster culture should be given the same facilities.

I trust that you will be able to let the department hear from you finally in the course of a short time.

I am, sir, your obedient servant,

C. STANTON,

Asst. Deputy Minister of Marine and Fisheries.

HALIFAX, August 30, 1910.

A. JOHNSON, Esq.,
Deputy Minister of Marine and Fisheries,
Ottawa, Ont.

DEAR SIR.—I beg to acknowledge receipt of your letter of August 5th, No. 2381, with reference to the oyster fishery. I regret to say that at present Mr. Barnstead is absent in England and it is difficult for me to write you as fully as you suggest. When Mr. Barnstead returns I shall take the matter up with him.

If you have entered into a *modus vivendi* with the province of Prince Edward Island, I would thank you to communicate full particulars of the same as it would assist me in considering the matter so far as Nova Scotia is concerned.

Yours truly,

A. K. MACLEAN,

Attorney General.

CHARLOTTETOWN, P.E.I., August 11, 1910.

A. JOHNSON, Esq.,
Deputy Minister of Marine and Fisheries,
Ottawa, Ont.

Re Oyster Fisheries, P.E.I.

DEAR SIR.—I have your your letter of the 5th instant and fully note its contents; also that you are communicating with the Attorneys General of Nova Scotia and New Brunswick to ascertain whether or not they are prepared to enter into an immediate arrangement regarding the oyster fishery, &c.

I will await futher correspondence in the matter with you.

Yours faithfully,

F. L. HASZARD,

Premier and Attorney General.

ST. JOHN, N.B., August 11, 1910.

Deputy Minister of Marine and Fisheries,
Ottawa.

Re 3381.

DEAR SIR.—I am in receipt of yours of the 5th inst., and have inclosed the same to Dr. Landry, who was the representative of the government at the conference to which you refer with respect to oyster fishery, and will write you as soon as I have had an opportunity of consulting with him about the matter.

Yours truly,

J. D. HAZEN.

Honourable F. L. Haszard, K.C.,
Premier and Attorney General,
Charlottetown, P.E.I.

August 5, 1910.

Dear Sir,—The minister carefully read your letter of the 28th ultimo, just before leaving for the west; but as time did not offer for him to reply thereto, he directed me to do so, to the following effect:—

He is quite in accord with your view that the *modus vivendi* to be entered into should make it perfectly clear that the granting by this department of the leases of the form that may be decided upon, will not, in any sense inure to its advantage in connection with the settlement of outstanding questions between federal and provincial governments regarding the fisheries.

After careful study of the conditions in connection with the oyster fishery in the United States and other countries, the department fee's that twenty years is the most satisfactory term for a leasehold, as it really takes several years, in most instances, to bring an area up to its highest yielding state, and while conditions appear to be such in the maritime provinces as will enable a very large industry in oyster culture to be built up, much knowledge will have to be acquired by experience, which, no doubt in no few instances, will not be of a pleasant character. The comparatively severe winters form a factor that has not to be reckoned with in the south eastern states, and while our oysters are much better in quality they are no doubt considerably slower in growth. Enemies of the young oyster, when they are cultivated in great numbers, such as the star-fish and certain borers, will quite likely make their appearance in such quantities as to make it essential for the oyster culturists to take special steps for their destruction.

Courage in the face of discouragement will therefore be necessary, especially on the part of the pioneer oyster culturists, to make a success of the venture, and the department therefore feels that those starting in the industry should not be hampered by such restrictions as heavy license fees. One dollar an acre is the current rate in most parts of the United States, even where a very large industry has been built up, and a heavier fee has in different cases been found impossible.

Of course, what your government, as well as this department, is mainly anxious for, is not as much the obtaining of revenue as the building up of a flourishing industry, and from the information available as to the time required to bring a bed into a really flourishing condition, the department is impressed that the fee should not be raised until ten years have elapsed.

A royalty in lieu of an acreage fee is from many points of view more satisfactory; but there is always room for misapprehension as to the number of barrels taken, and all things considered it would seem that an acreage fee is preferable.

There can be little question that for a number of years to come a comparatively small area will be all that any one culturist will be prepared to handle and the department is, therefore, in accord with your view, that five acres is, at least for the present, a sufficiently large area.

With regard to the experimental plot which you are informed was being built up in Richmond Bay, I am pleased to inform you that work has been progressing on the plot and it is anticipated that when the oyster fishing season opens it will be quite ready to receive a seeding of oysters.

The minister is also in accord with your view that it would be more desirable to have each of the maritime provinces enter into a *modus vivendi* at the same time, notwithstanding that if such cannot be done the public interest of the island would be served by immediately starting operations there, and therefore before finally considering the terms of a *modus vivendi*, I am communicating with the Attorneys General of Nova Scotia and New Brunswick, with a view to ascertaining whether or not they

are prepared to enter into an immediate arrangement, and I am taking the liberty of stating that you view with favour an arrangement that may be decided upon of a satisfactory character.

Yours faithfully,

A. JOHNSON.

August 6, 1910.

Honourable A. K. Maclean,
Attorney General,
Halifax, N.S.

Sir,—You will no doubt remember that in May of last year, a delegation consisting of one representative from each of the maritime provinces came to Ottawa, with a view to endeavouring to arrange with this department the basis of a *modus vivendi* in connection with the oyster fishery, to enable steps to be taken to start the great improvements which could doubtless be made in the industry in question, if conditions were practicable to proceed with the leasing of areas on which persons could engage in oyster culture operations and so directly interest private enterprise in the venture.

The three representatives were Honourable D. B. Landry, M.D., for your province; Mr. R. H. Montgomery, for Prince Edward Island, and Mr. A. S. Barnstead for Nova Scotia.

I understand that before coming to Ottawa they held a conference, at which it was understood that certain decisions were reached, and after a full and free discussion of the matter in the department here, a basis of *modus vivendi* was drawn up, a copy of which was given to each representative, it being understood that immediately following their return home they would take the matter up with their respective governments, when they would be able to jointly submit a recommendation, embracing the terms of a *modus vivendi* to the federal government, as it was not thought that there was any serious divergence likely to arise in considering the final terms of such *modus vivendi*

Time, however, went on and nothing further was heard by the department on the subject, and as Mr. Barnstead had undertaken to make all the arrangements with the other delegates he was written to on more than on occasion, urging some final action; but for one reason and another nothing appears to have been done.

The possibilities of building up a vast oyster industry in the maritime province, if proper facilities were given private enterprise, are so well known to you that it is quite unnecessary for me to dwell on the point and it is really too bad that the unfortunate unsettled state of the question of fishery rights should be allowed to continue to intervene to prevent steps being taken to enable a satisfactory extension of the industry.

Doubtless you have before you the notes for a *modus vivendi* that were drawn up with the delegates when in Ottawa; but in case you may not have such at hand, I have pleasure in inclosing a copy thereof herewith, and I should be very much obliged for a full expression of your views in the premises at the earliest possible moment.

I may add that in view of no final action being taken following the visit of the delegates the department has recently entered into correspondence with the Attorney General for Prince Edward Island, as the possibilitis for oyster culture are probably greater there than in any of the other provinces, and he has expressed his willingness to immediately enter into a *modus vivendi* of a satisfactory nature, which would enable this department to, in the public interest, do everything possible to speedily and comprehensively develop the oyster industry.

I may also say that with a view to practically illustrating what may be done by private oyster culture it has been decided to build up a few experimental oyster beds

on areas that have never before been oyster producing, and a start in this direction has already been made, as an area has been selected in Richmond Bay, Prince Edward Island, which is being prepared by this department's oyster expert, on which oysters will be laid down this fall.

While it will be necessary in the event of a *modus vivendi* with the three maritime provinces not being reached, to consider the question with each province individually, I am sure you will appreciate the advantage of united action in the premises, and I should be obliged for your reply at the earliest possible moment, in order that final action may be considered.

I am, sir, your obedient servant,

A. JOHNSON,

Deputy Minister of Marine and Fisheries.

August 8th, 1910.

SIR,—You will no doubt remember that in May of last year a delegation consisting of one representative from each of the maritime provinces came to Ottawa with a view to endeavouring to arrange with this department the basis of a *modus vivendi* in connection with the oyster fishery, to enable steps to be taken to start the great improvements which could doubtless be made in the industry in question, if conditions were practicable to proceed with the leasing of areas on which persons could engage in oyster culture operations, and so directly interest private enterprise in the venture.

The three representatives were Honourable D. B. Landry, M.D., for your province, Mr. R. H. Montgomery, for Prince Edward Island, and Mr. A. S. Barnstead, for Nova Scotia.

I understand that before coming to Ottawa they held a conference, at which it was understood that certain decisions were reached, and after a full and free discussion of the matter in the department here, a basis of *modus vivendi* was drawn up, a copy of which was given to each representative, it being understood that immediately following their return home they would take the matter up with their respective governments, when they would be able to jointly submit a recommendation, embracing the terms of a *modus vivendi* to the federal government, as it was not thought that there was any serious divergence likely to arise in considering the final terms of such *modus vivendi*.

Time, however, went on and nothing further was heard by the department on the subject, and as Mr. Barnstead had undertaken to make all arrangements with the other delegates he was written to on more than one occasion, urging some final action; but for one reason and another nothing appears to have been done.

The possibilities of building up a vast oyster industry in the maritime provinces, if proper facilities were given private enterprise, are so well known to you that it is quite unnecessary for me to dwell on the point and it is really too bad that the unfortunate unsettled state of the question of fishery rights should be allowed to continue to intervene to prevent steps being taken to enable a satisfactory extension of the industry.

Doubtless you have before you the notes for a *modus vivendi* that were drawn up with the delegates when in Ottawa; but in case you may not have such at hand, I have pleasure in inclosing a copy thereof herewith, and I should be very much obliged for a full expression of your views in the premises at the earliest possible moment.

I may add that in view of no final action being taken following the visit of the delegates the department has recently entered into correspondence with the Attorney General for Prince Edward Island, as the possibilities for oyster culture are probably greater there than in any of the other provinces, and he has expressed his willingness

to immediately enter into a *modus vivendi* of a satisfactory nature, which would enable this department to, in the public interest, do everything possible to speedily and comprehensively develop the oyster industry.

I may also say that with a view to practically illustrating what may be done by private oyster culture it has been decided to build up a few experimental oyster beds on areas that have never before been oyster producing, and a start in this direction has already been made, as an area has been selected in Richmond Bay, Prince Edward Island, which is being prepared by this department's oyster expert, on which oysters will be laid down this fall.

While it will be necessary in the event of a *modus vivendi* with the three maritime provinces being reached, to consider the question with each province individually, I am sure you will appreciate the advantage of united action in the premises, and I should be obliged for your reply at the earliest possible moment in order that final action may be considered.

I am, sir, your obedient servant,

A. JOHNSON,

Deputy Minister of Marine and Fisheries.

Honourable J. D. HAZEN, K. C.,
Premier and Attorney General,
Fredericton, N. B.

CHARLOTTETOWN, P.E.I.,
July 26th, 1910.

DEAR SIR,—

Re Oyster Fisheries, P.E.I.

I am receipt of your favours of June 6 and July 6 regarding the *modus vivendi* in connection with the oyster fisheries. I have necessarily, had to delay replying to your letters until I could consult with some of the members of the executive who were not here, and now in reply. I beg to say that so far as we are concerned I think our government would be willing to enter into a *modus vivendi* regarding the oyster fisheries on its own account, if the other provinces could not be got to agree. However, I think, there would be no reason why all should not be bound by the same regulations.

If a contract is really made between the Dominion and Provincial governments by which it would be agreed that leases should be given by either one government or the other, and that the granting of such lease should not inure to the advantage or disadvantage of either government, then, to my mind, there would be no objection to the Dominion government granting the leases.

In my opinion the length of the lease should not extend over twenty years; for the first five years at, say, $1 an acre with the condition that unless the lessee proceeds with the planting of beds within the first three years the lease should be subject to forfeiture. At the end of five years the rent could be increased to at least $2 per acre or the parties taking the oysters be subject to the payment of a royalty or certain sum per barrel, say fifty cents. The lease should be assured to the lessee by the joint covenants of both governments, securing it in any event; no change to be made without the consent of both contracting parties. The revenue might be collected by the federal government and should be divided equally with the province. We should be entitled to at least fifty per cent of the gross amount collected from all sources in connection with the fisheries. The area to be granted, I think, should not exceed five acres.

With regard to the present beds, I do not think there would be any objection to dividing them into two or three sections and having them fished during alternate years, either every second or third year, as the case might be. Provision, should, however, be made to allow a certain quantity of oysters to be taken off, under the direction of a proper inspector, for the planting of new beds. Provision regarding experimental plots, as you suggest, I think is very desirable; also as regards uniform barrels. Proper provision would also have to be made for the stocking of private beds, also for the preservation of special rights for mussel-mud for the farmers. If a contract as outlined above is drawn up, I will have it submitted to our government and give you a reply as quickly as possible. There may be some other suggestions which necessarily would have to be incorporated in it, but the whole matter depends largely upon proper protection; all the provisions as above suggested would be of little avail unless a different and better system of oversight can be organized. The present employment of a large number of men at ridiculous salaries is of little use, one man with a good outfit, paid a reasonable sum would be far more effective than five under present system.

We are very anxious to have this matter takn up and dealt with energetically at an early date and will give any assistance we can to bring it to a satisfactory settlement.

Yours faithfully,

F. L. HASZARD,

Attorney General.

Honourable L. P. BRODEUR,
Minister of Marine and Fisheries,
Ottawa, Ont.

July 6, 1910.

DEAR MR. HASZARD,—You will remember that on the 6th ultimo, I wrote you fully explaining the standing of a proposed *modus vivendi* by this department and the governments of the maritime provinces to enable the development of the oyster industry by leasing of oyster beds; but up to the moment I have not received any reply from you in the premises.

I am sure you will agree that it is most desirable that some amicable arrangement should be immediately reached in the matter, as there can be no doubt that the industry could be enormously devloped by the introduction of an adequate leasing system under conditions which would assure the leaseholders efficient protection of their holdings.

In view of the fact that there are such immense possibilities in the way of oyster culture in Prince Edward Island, I would be prepared to consider the question with your province alone if necessary, and I should, therefore, be much obliged if you would, at your earliest convenience, favour me with a full expression of your views on the whole subject.

Yours faithfully,

L. P. BRODEUR.

June 6, 1910.

HONOURABLE F. L. HASZARD, K.C.,
Premier of Prince Edward Island,
Charlottetown, P.E.I.

DEAR MR. HASZARD,—You will no doubt remember that in May last year a delegation consisting of one representative from each of the maritime provinces came to

Ottawa, with a view to endeavouring to arrange with my department the basis of a *modus vivendi* in connection with the oyster fishery, to enable steps to be taken to start the vast impovements which could no doubt be made in the industry in question, if it were practicable to proceed with the leasing of areas, and so directly interest private enterprise in oyster culture.

The three representatives, consisting of Mr. R. H. Montgomery, from your province; Mr. A. S. Barnstead, for Nova Scotia; and Honourable D. V. Landry, M.D., from New Brunswick, it appears had a conference before coming to Ottawa, when it was understood certain decisions were reached and after a full and free discussion of the matter in the department a basis of a *modus vivendi* was drawn up, a copy of which was given to each representative, it being understood that immediately on the return to the provinces they would take the matter up with their respective governments, when they would be able to submit jointly a recommendation embracing the terms of the *mouds vivendi* to the federal government, as it was not thought that there was any serious divergence of opinion likely to arise in considering the final terms of the *modus vivendi*.

Time, however, went on, and nothing further was heard by the Department on the subject, and Mr. Barnstead, who agreed to make all the arrangements with the other delegates, was written to on different occasions urging some final action; but up to the moment nothing appears to have been done.

The possibilities of extending the oyster fishery in the maritime provinces are so well known to you that it is quite unnecessary for me to dwell upon that point, and it really seems too bad that on account of the unsettled state of the question of fishery rights, steps looking to the immediate and great extension of the industry should be stayed.

No doubt you have before you the notes for a *modus vivendi* that were drawn up at the conference with the delegates when in Ottawa; but in case it may not be near at hand, I inclose a copy thereof, and I should be much obliged for an expression of your views in the whole matter.

I may add that, in order to place before those who are in a position to take up private oyster culture, as an object lesson in the matter, I have authorized the oyster expert to select an area in Richmand bay on which oysters do not exist at the present time, nor ever have in the past, and on it build up an oyster bed, and stock it during the coming season.

An area has been chosen off the south side of Bird island or Middle island, just to the east of the mouth of Bideford river. The extent of the area is four acres. It is in the open bay, so that there could be no question of private ownership, and I trust that your government will do all it can towards and co-operate with my department in making this experimental bed an entire success.

Yours faithfully,

G. J. DESBARATS.

Hon. F. L. Haszard, K.C.,
Premier of Prince Edward Island,
Charlottetown, P.E.I.

Ottawa, December 8, 1909.

Dear Mr. Barnstead,—Ever since your letter of the 14th September last intimating that you have the matter of a proposed *modus vivendi* in connection with the conduct of the oyster fishery attended to with all possible speed, and I have been hoping to hear from you further on the subject.

You will remember that the other two delegates who were here when you were to take the matter up with your respeceive governments on their return home, and

were to communicate with you, in order that a joint recommendation embracing the terms of a *modus vivendi*, should be submitted.

The department has before it different applications for leases to cover areas on which to carry on oyster culture, which of course it has not been possible for it to deal with, and as it is of very great importance that some satisfactory arrangement should be reached without delay, I should be obliged to hear from you as to how the matter now stands.

Yours very truly,

R. N. VENNING.

A. S. BARNSTEAD, Esq.,
Department of Industries and Irrigation,
Halifax, N.S.

HALIFAX, September 14, 1909.

MR. R. N. VENNING,
Department of Marine and Fisheries,
Ottawa.

DEAR SIR,—I beg to acknowledge your letter of the 11th inst., respecting the fisheries.

The Attorney General is at the present time in the west and will not be back for a week or ten days and no further progress can be made until his return. As soon as possible, however, I will have the matter attended to.

Yours truly,

ARTHUR S. BARNSTEAD,
Secretary.

OTTAWA, September, 11th, 1909.

DEAR MR. BARNSTEAD,—Please pardon my delay in replying to your letter of the 26th ultimo, which is due to the fact my time has been greatly taxed since my return from British Columbia, where I found it necessary to go during the present summer on some departmental matters.

I am very glad indeed to see that you have again taken up the matter of a *modus vivendi* in connection with the oyster industry with the other maritime provinces, and I shall hope to hear from you at an early date that some conclusions have been reached in connection therewith.

With regard to your inquiry as to what is being done in regard to some matters which were talked over with you and your confreres when here, I may say that I have been following them up and have already obtained considerable information in regard to the establishing of experimental oyster beds.

Yours very truly,

R. N. VENNING.

A. S. BARNSTEAD, Esq.,
Department of Industries and Irrigation,
Halifax, N.S.

HALIFAX, August 26, 1909.

R. N. VENNING, Esq.,
Superintendent of Fisheries,
Ottawa.

DEAR SIR,—I have your letter of the 19th inst., relative to our visit to Ottawa respecting the oyster fisheries.

On my return to the city I immediately referred the matter to our provincial government. It was not in session at the time, the members were away, and it was some little time before I got the matter fully in hand. It was thereafter referred to the Attorney General's Department to be looked into from a legal point of view and I have not since had an opportunity of talking it over. It is one of the very important matters which I propose looking into immediately.

I have not heard at all from the other provinces.

I noticed the other week that you were out on the coast, and was resting easy on that account. You had planned, I understood, to have visited the province this summer. Have you decided against a visit here?

I shall take the matter up immediately with the other governments and find out whether they have succeeded in securing a basis for a *modus vivendi*. As far as our government is concerned there will be no difficulty in the matter.

What has been done on your part in regard to the several matters which you were to look into and upon which you were to obtain reports?

Yours truly,

Sgd. ARTHUR S. BARNSTEAD.

Secretary.

August 18, 1909.

3381

SIR,—Adverting to your visit and that of Dr. Landry, of New Brunswick, and Mr. Montgomery, of Prince Edward Island, to the department in May last, and to my letter to you of the 27th of that month, I may say that it was anticipated, as indicated therein, after the return of the different delegates that they would, after conferring with their governments, submit a joint recommendation embracing the terms of a *modus vivendi* in connection with the administration of the oyster fisheries in the maritime provinces.

Though I have been hoping from week to week since that time to have heard from you on the subject, up to the moment nothing has reached the department either from any of the delegates or from the provincial governments interested, and I should be much obliged if you would be good enough to inform me how the matter now stands.

I am, sir,

Your obedient servant

R. N. VENNING.

A. S. BARNSTEAD, Esq.,
Department of Industries, and
Irrigation, Superintendent of Fisheries,
Halifax, N.S.

May 27, 1909.

SIR,—At the preliminary conference with representatives from the maritime provinces, with the Honourable L. P. Brodeur, Minister of Marine and Fisheries, and myself as Dominion Superintendent of Fisheries, on the 28th May, instant, the Minister relegated me to act in a subsequent conference to continue the discussion as to the basis of a *modus vivendi* between the Dominion government and the governments of New Brunswick, Nova Scotia and Prince Edward Island, having for its object the preservation, protection and development of the oyster fisheries of the maritime provinces, pending a decision on a reference to be made to the courts as to the relative rights and jurisdiction in the waters below low water mark.

To this end we very fully discussed the matter in all its bearings and reached certain points for consideration to be submitted to your government, a memorandum of which I herewith inclose.

It is expected that after each of the delegates from the provinces has reported to his government on these lines, to which the Dominion government tentatively agrees as forming a basis, that they will be able to submit jointly a recommendation embracing the terms of the *modus vivendi* to the federal government, and it is not thought that any serious divergence of opinion is likely to arise in considering the final terms of the *modus vivendi*.

In all probability any legal difficulty will be eliminated by the suggested insertion in the lease of words limiting the conveyance of rights and privileges to such as may be legally conveyed by the Minister of Marine and Fisheries.

I am, sir,

Your obedient servant,

R. N. VENNING,
Supt. of Fisheries.

CHARLOTTETOWN, P.E.I., May 23, 1909.

Hon. L. P. BRODEUR,
Ottawa.

Sending delegate oyster fisheries, meet you Wednesday, assume your department will pay expenses.

F. L. HASZARD.

OTTAWA, May 20, 1909.

ARTHUR S. BARNSTEAD,
Halifax, N.S.

Will meet you and other delegates oyster industry, Wednesday twenty-sixth May, at eleven forty-five a.m., my office. Please inform other delegates.

L. P. BRODEUR.

HALIFAX, May 12, 1909.

HON. L. P. BRODEUR,
Minister, Marine and Fisheries,
Ottawa.

SIR,—Under instructions from Hon. Premier Murray and in co-operation with the representatives of the governments of New Brunswick and Prince Edward Island, we have come to an agreement on certain matters in connection with the conserving and developing of the oyster industry in these provinces. In view of the, to some extent, joint jurisdiction both of the Dominion government and the various provincial governments, we felt that the matter was one in which we should come to some agreement among ourselves and thereafter discuss the conclusions arrived at with yourself as representing the Department of Marine and Fisheries.

I had hoped that we had finished our work and reported to our governments and had been in Ottawa before Mr. Murray returned, but were unable to do this. We hope, however, to leave on Saturday, after seeing Mr. Murray, and discuss this among other matters, there.

Would it be possible for you to indicate by wire what day next week would be convenient for you to meet with us to present our views in this matter? The representatives from the other provinces leave on Monday, arriving there in time to have a conference with you at any hour Wednesday or Thursday.

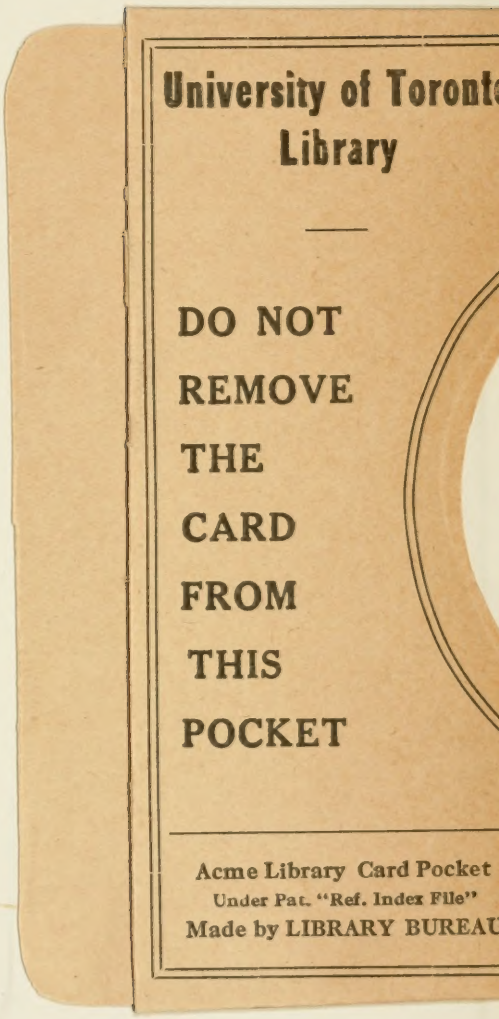
Might I suggest that in view of the fact that you have an officer specially delegated to do the work in this connection, that it might be advisable to have his services at the conference. I refer to Capt. Ernest Kemp who is engaged in the work in the Northumberland Straits. I assume he is accessible at any time now. I may add an expression of our appreciation of his services which were kindly given the committee of the Nova Scotia government a short time ago in the preliminary discussion leading to the conference, which took place in Moncton.

I have the honour to be, sir,

Your obedient servant,

Sgd. ARTHUR S. BARNSTEAD.

Secretary.


University of Toronto
Library
DO NOT
REMOVE
THE
CARD
FROM
THIS
POCKET
Acme Library Card Pocket
Under Pat. "Ref. Index File"
Made by LIBRARY BUREAU